BUS SERVICE RELIABILITY

MBTA ADVISORY BOARD STAFF REPORT

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MBTA BUS SERVICE RELIABILITY: STANDARDS AND SUPERVISION

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SEPTEMBER 1986

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PREFACE

This report presents the results of a study of bus service reliability and performance monitoring practices at the MBTA. The report was prepared for the MBTA Advisory Board by Andrew J. Tsihlis under the direction of Anne M. Larner, Executive Director. Research, data collection and analysis took place over the course of several months in 1985 and 1986.

The author wishes to thank the following individuals for their input and comments during the course of the project:

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The author wishes also to thank the many MBTA employees and others who assisted at various stages of the project.

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EXECUTIVE SUMMARY

Despite the importance of service reliability to passengers, the MBTA, along with most American transit agencies, fails to include reliability as a measure of service performance. Though the MBTA deserves credit for improving bus service performance since the early 1980s by reducing the number of missed bus trips, missed trips are only one measure of performance. Generally, passengers consider service to be reliable when it operates according to previously set headways (the number of minutes between trips) and schedules.

Observation and analysis of selected MBTA bus routes by the Advisory Board study team showed that the majority of routes tested operated with extremely variable headways and would likely be perceived as unreliable by passengers. Further analysis of headway data and field observations underscored two points. First, MBTA bus service reliability appears to be directly related to the level of field supervision; second, Inspectors and Chief Inspectors are hampered in their attempts to regulate headways by built-in inadequacies in the MBTA's scheduling and training process.

Though some factors affecting bus service reliability tend to be unpredictable, the MBTA can take steps to increase its ability to recognize and respond to them. Stability of service is directly related to the roles vehicle operators and first-line managers are assigned and the tools they are given. This report recommends changes in field supervision as a method of improving reliability. Findings and recommendations of the study include:

1. No single manager or department at the MBTA is responsible for monitoring and regulating service reliability.

Recommendation: The MBTA should either create the position of Manager of Service Reliability in the Transportation Department or consider the formation of a Traffic Section whose main responsibility would be to monitor service delivery.

2. Current standards for evaluating bus service are overly ambitious and often ignored.

Recommendation: The current Service Policy needs to be redesigned. Standards for service delivery should be developed which are both realistic and attainable. Standards which measure intermediate and terminal arrival times as well as headway variability should be appended to the current Service Policy.

3. Bus schedule adherence is not measured by the MBTA.

Recommendation: Schedule adherence needs to be a regular part of MBTA measurement of bus service performance. Lists showing when buses are due at intermediate and terminal points should be constructed from running time sheets and distributed to all Inspectors and Chief Inspectors. Schedule adherence spot-checks should be made a daily requirement of all Inspectors and Chief Inspectors.

4. Scheduled recovery time/trip time ratios exceed existing policy standards.

Recommendation: Scheduled running time sheets should be regularly updated to reflect real operating conditions. Timetable running times should reflect running time sheets. Nonproductive layover time should be reduced wherever possible.

5. Drivers are required to adhere to schedules but they are not supplied with intermediate or terminal arrival time information.

Recommendation: Every MBTA bus driver should be supplied with a card, or driver paddle, which shows departure and arrival times specific to his/her work assignment.

6. The MBTA does not monitor individual driver performance on a routine basis.

Recommendation: The MBTA should make regular on-board spot-checks of its drivers, especially in response to complaints and accidents.

7. **The role of Inspectors and Chief Inspectors is poorly defined.**

Recommendation: Inspectors and Chief Inspectors are first-line transportation supervisors whose job includes regulating service. Their training and recertification programs should place more emphasis on this function in addition to current training in public safety.

8. **Inspectors and Chief Inspectors have minimal input into the operational planning process.**

Recommendation: The MBTA should institute regular discussion sessions where Inspectors and Chief Inspectors can express their ideas and recommendations for operational changes both among themselves and to their supervisors.

9. **Inspectors and Chief Inspectors need the proper tools and information to do their jobs.**

Recommendation: All MBTA field supervisors should be supplied with properly functioning portable radios, vans and tool kits (for mobile Chief Inspectors). In addition, MBTA field personnel should be provided with troubleshooting guides which outline spot-maintenance procedures for each type of surface vehicle operating in revenue service.

10. **The MBTA's current practice of centralizing field supervision of bus service at rapid transit terminals prevents Inspectors from monitoring service along a route and contributes to unreliable service.**

Recommendation: The MBTA should continue to base field personnel at rapid transit stations. However, each Inspector and Chief Inspector should be required to make random spot-checks of service performance (schedule adherence and operator driving habits) at various points in the vicinity of his/her base.

CHAPTER 1: INTRODUCTION

1.1 Objective

Providing reliable bus service to a region appears at first glance to be a relatively simple undertaking. Yet, a close look at the fine-tuned coordination which is necessary among a number of actors in order to bring a bus to a local stop at a predictable time paints another picture. This study started as a brief look at the MBTA's curb side bus service from a passenger point of view and quickly developed into a much broader analysis of the complex elements which must come together to ensure regular and predictable service to the communities in a transit district.

As the study developed into a more complex undertaking, its primary objective remained the same, to look at the issue of reliability of service. Service reliability has been defined as the consistency of headway, travel time and comfort.[1] To arrive on-time at a particular destination is what is most important to the average passenger.[2]

It is hoped that a broad based approach to the subject does not downplay the importance of predictable and consistent service, but

1 - Englisher, Larry, Minneapolis-St. Paul Service Reliability Demonstration, Multisystems, UMTA Report MA-06-0049-83-8, April 1984.

2 - Wachs, Martin, "Consumer Attitudes Toward Transit Service: An Interpretative Review," Journal of the American Institute of Planners, 42 Number 1 (January 1976): 96-104.

rather underscores the need for strong planning, constant reevaluation of service levels, allocation of adequate resources and good coordination.

The study report focuses on:

a.) reliability standards currently in use by the MBTA;

b.) the monitoring of those standards; and,

c.) techniques available to regulate service reliability, both in general and at the MBTA.

In addition, the study uses a test sample of routes to assess the reliability of MBTA bus service from the passenger's standpoint.

The MBTA's standards for reliability and a look at how MBTA bus service compares to those standards is presented in Chapters 2 and 3. MBTA schedule-making procedures are reviewed in Chapter 4. Chapter 5 evaluates techniques for field supervision of bus operations.

1.2 Background

Over the last 20 years, studies have shown service reliability to be one of the most important factors used by passengers in determining modal choice and travel patterns. In practice, service is seen by consumers as reliable if it operates according to published schedules.

> "Perhaps the primary measure of reliability is whether the user perceives the system or link as likely to perform the same daily task on the same schedule." [Passenger Psychological Dynamics, American Society of Civil Engineers (1968)]

> "The most important attribute was that the bus arrive on schedule." [Fielding, Gordon J., Consumer Attitudes Toward Public Transit, Transportation Research Board, Number 563 (1977)]

"The basic measure of reliability is the predictability of arrival time." [Altshuler, Alan, The Urban Transportation System - Politics and Policy Innovation, (1978)]

Service reliability is important to both the transit user and the transit agency. To the user, nonconformance with schedules means increased wait times, difficulty in transferring to other services and uncertain arrival times at a destination. For transit agencies, unreliable service reduces productivity and increases costs. Deviation from the schedule creates the need to build additional travel and recovery time into timetables which leads to less efficient use of both vehicles and manpower.

In order to evaluate a transit system's reliability, it is necessary to understand what factors affect a passenger's perception of reliable service. For this purpose, it is helpful to divide transit users into two groups. The first group is made up of riders who use transit service without first consulting a schedule. For these passengers, reliability is judged by the variability of service performance (i.e., wait time, travel time, connecting times, etc.) from their average daily experience. The second group of riders use published schedules and measure service reliability based on the deviation of actual service from scheduled departure times and headways.

Perceptions of reliability are further affected by the level of schedule detail provided by timetables. Timetables which include specific arrival times at selected intermediate and terminal points allow passengers to base reliability on schedule adherence. MBTA bus routes average from 4.5 to five miles in length and have roughly between 20 and 40 intermediate stops. Most MBTA timetables show only

scheduled headways and terminal departure times (cf. Figure I) making headway variability the most useful measure of reliability for both MBTA passengers and managers. Therefore it is this measure which we have used in evaluating T service.

FIGURE I

EXAMPLES OF MBTA PUBLIC TIMETABLES

450 (T) **WINTER 1986**
(9M) EFF 12/28/85 03/27/86

SALEM — BOSTON
VIA HIGHLAND & WESTERN AVE.

WEEKDAY		SATURDAY		SUNDAY	
Leave Salem Center	Leave Haymarket Square	Leave Salem Center	Leave Haymarket Square	Leave Salem Center	Leave Haymarket Square
6:00AM	6:45AM	7:30AM	7:30AM	9:00AM	8:15AM
6:20	7:15	8:25	8:30	10:00	9:15
b 6:20	8:00	9:20	9:30	11:00	10:15
6:40	8:10	10:20	10:30		11:15
b 6:40	9:00	11:20	11:30		
7:00	10:00				
b 7:00	11:00				
7:15					
7:25					
a 7:28					
7:35					
7:45					
8:00					
b 8:20					
8:30					
8:50					
9:20					
9:50					
10:50					
11:50					
12:50PM	12:00N	12:20PM	12:30PM	12:00N	12:15PM
1:50	1:00PM	1:20	1:30	1:00PM	1:15
2:50	2:00	2:20	2:30	2:00	2:15
3:20	3:00	3:20	3:30	3:00	3:15
4:00	e 3:45	4:20	4:30	4:00	4:15
5:00	c 4:00	5:20	5:30	5:00	5:15
6:15	4:20	6:20	6:30	6:00	6:15
7:15	c 4:30	7:18	8:00	7:00	7:15
8:45	a 4:40	8:45	9:30	8:00	8:15
	c 4:50			9:00	9:45
	a 5:00				
	c 5:08				
	5:13				
	d 5:18				
	c 5:23				
	5:35				
	c 5:55				
	6:05				
	6:30				
	8:00				
	9:30				

HOLIDAYS:
Jan 1—See SUNDAY
Jan 20—See SATURDAY
Feb 17—See SATURDAY

FARE ZONES
EXACT CHANGE REQUIRED

VALID PASSES
Plan A – local C D E F

Toll Free Information
1-800-392-6101

a—Thru service to Danvers
b—Eastern Ave. & Essex to Haymarket
c—Haymarket to Eastern Ave. & Essex St
d—Haymarket to Happy Valley via Western Ave. & Chestnut St
e—Western Ave. & Chestnut St. to Boston leaves from Happy Valley

Schedules subject to change

450 MAP

FOR ASSISTANCE CALL THE (T) 722-3200
COMMUNICATIONS DEPT

60 (T) **WINTER 1986**
(11M) EFF 12/28/85 03/27/86

CHESTNUT HILL — KENMORE
VIA BROOKLINE VILLAGE
& CYPRESS ST.

WEEKDAY		SATURDAY		SUNDAY	
Leave Chestnut Hill	Leave Kenmore	Leave Chestnut Hill	Leave Kenmore	Leave Chestnut Hill	Leave Kenmore
5:00AM	c 4:45AM	5:00AM	c 4:45AM	6:30AM	6:00AM
5:25	c 5:10	5:25	c 5:10	7:30	7:00
5:50	5:25	5:50	5:22	8:30	8:00
6:13	5:50	6:15	5:47	9:30	9:00
6:30	6:13	6:40	6:12	10:30	10:00
6:47	c 6:15	7:05	6:37	11:30	11:00
7:04	6:30	7:30	7:02		
7:21	6:47	Ev 30 min Until 11:30	7:30		
7:38	7:04		Ev 30 min Until 11:30		
7:55	7:21				
8:12	7:38				
8:29	7:55				
8:46	8:12				
9:03	8:29				
9:20	8:50				
Ev. 30 min. Until 11:50	Ev 30 min. Until 11:50				
12:20PM	12:10PM	12:00N	12:00N	12:30PM	12:00N
12:45	12:35	12:32PM	12:30PM	1:30	1:00PM
1:10	1:04	1:03	1:02	2:30	2:00
1:39	1:32	1:35	1:33	3:30	3:00
2:07	2:00	2:07	2:05	4:30	4:00
2:35	2:28	2:36	2:37	5:30	5:00
3:03	2:56	3:10	3:08	6:30	6:00
3:30	3:22	3:41	3:40	7:30	7:00
4:00	3:44	4:13	4:11	8:30	8:00
4:21	4:04	4:44	4:43	9:30	9:00
4:42	4:22	5:16	5:14	10:30	10:00
5:00	4:40	5:47	5:46	11:30	11:00
5:18	4:58	6:19	6:17	12:30AM	12:00M
5:36	5:16	6:50	6:50	b 1:22	1:00AM
5:54	5:34	7:15	7:15		
6:15	5:52	7:40	7:40		
b 6:20	6:10	8:05	8:05		
6:45	6:30	8:30	8:56		
b 7:00	6:45	9:20	9:48		
7:15	7:16	10:10	10:35		
7:45	7:45	11:00	11:25		
8:15	8:15	11:50	12:15AM		
b 8:45	8:45	12:40AM	1:00		
9:15	9:45	b 1:22			
10:15	10:45				
11:10	11:30				
11:55	12:15AM				
12:40AM	1:00				
b 1:22					

HOLIDAYS:
Jan 1—See SUNDAY
Jan 20—See SATURDAY
Feb 17—See SUNDAY

b—Chestnut Hill to Brookline Village
c—Brookline Village to Chestnut Hill

FARE 50¢
EXACT CHANGE REQUIRED

VALID PASSES
Plan A C D E F

Schedules subject to change

60 MAP

FOR ASSISTANCE CALL THE (T) 722-3200
COMMUNICATIONS DEPT

Most large bus systems, the MBTA included, ignore headway variability and monitor service reliability by a percentage variance from

a fixed schedule of departure and arrival times. Transit systems generally use average measures of performance such as mean on-time performance and average speed to measure service delivery. These measures by themselves fail to capture important aspects of the service experience of a significant percentage of riders.

In the past, only minimal technical research in the American transit industry has focused on transit service reliability. In the late 1970s, the Urban Mass Transportation Administration (UMTA) began examining bus service reliability as part of its Service and Methods Demonstration (SMD) program. The final report concluded that:

> ...Operators are more concerned about predictability of bus arrival time at terminals than at intermediate points, despite the importance of the latter for passengers. This is probably due to the driver's concern with layover time at the terminal and the operator's desire not to delay the next trip, as well as difficulty in monitoring intermediate points. Budget and resource constraints also severely restrict the operator's ability to improve the situation.3

UMTA's 1978 reliability study called for additional research on the subject of transit service variability and recommended demonstrations to test the effectiveness of various surveillance and control strategies. As a result of the UMTA study, a test case demonstration was conducted during 1983 at the Metropolitan Transit Commission (MTC) in Minneapolis-St. Paul. A noteworthy finding of the Minneapolis project was that in the presence of field supervisory personnel, both in and out of view, MTC drivers tended to be more aware of their driving habits resulting in less variable service.

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3 - Abkowitz, et al., Transit Service Reliability, Transportation Systems Center, Report UMTA-MA-06-0049-78-1, December 1978.

CHAPTER 2: MBTA MEASUREMENT OF BUS SERVICE RELIABILITY

2.1 The MBTA Bus System

The MBTA currently operates approximately 175 bus routes in the Greater Boston area, not including various short-turn routes or route branches. Over 7,000 trips are scheduled each weekday with peak period headways ranging from two to 60 minutes. Three distinct types of bus service are provided: urban local service, suburban local service and limited-stop express service.

To provide service, the MBTA maintains a bus fleet in excess of 1,000 vehicles. A maximum of 800 buses are assigned during each peak period. They are serviced and maintained at eight garages located throughout the metropolitan area. According to MBTA bus maintenance officials, in 1985 the average age of the MBTA bus fleet was 9.8 years.

During the field study, the newest vehicles in the MBTA's bus fleet were the 9100 and 9400-series Flyer coaches which were delivered during 1981 and 1982. Hoping to lower the average age of the fleet and increase fleet availability, in 1985 the MBTA ordered 200 General Motors RTS-II-04 advanced-design buses. Although none were in service during the data collection phase of this study, all 200 vehicles have since entered revenue service. The success of the RTS bus prompted the MBTA to order an additional 180 RTS-II buses during the first half of 1986.

To operate its vehicles, the MBTA employs over 1,400 full and part-time bus Operators, each of whom is based at one of seven seniority rating stations. The performance of drivers and vehicles is supervised by more than 110 Inspectors stationed at key locations and nearly 40 Chief Inspectors who oversee the performance of Inspectors and are assigned to radio and tool-equipped vans. Although the MBTA employs Inspectors and Chief Inspectors to regulate service along its heavy and light rail lines, their duties differ from bus service Inspectors and will not be discussed in this report.

The MBTA is a multi-mode radial system using downtown Boston as the focal point. Most MBTA passengers use more than one vehicle to complete their journey and bus to rail transfers are the most prevalent.[4] Some circumferential bus routes exist, but the vast majority of routes are radial. Approximately 94% of the MBTA's bus routes intersect with one of the four rapid rail lines and of those routes, 91% have rapid transit stations as one of their terminals. The MBTA centralizes most of its field supervision for buses at these rapid transit stations.

2.2 Development of the MBTA Service Policy

For the first decade after its establishment in 1964, the MBTA regulated, modified and operated its bus service without the guidance of formal performance standards. Service changes were based on the availability of manpower, vehicle and funding resources together with political considerations. Little emphasis was placed on evaluating

4 - Addante, Evelyn Y., 1983 Fare-Mix Sampling Program: Analysis and Documentation, Central Transportation Planning Staff (December 1984) p. 26.

the performance of currently operating service.

Concerned with the equity of service changes and the effectiveness of the entire operation, the Advisory Board prompted MBTA officials to formulate service standards. Development of those standards took place during 1975. With the January 1976 approval of the MBTA's Service Policy for Surface Public Transportation, the Advisory Board adopted formal standards for bus service planning and performance.

The Policy is a consolidation and strengthening of previously disparate service standards and guidelines. Initial chapters outline legal and policy parameters. Subsequent chapters detail service goals and objectives, performance standards, socioeconomic and environmental considerations, service planning processes and ammendment procedures.

Several minor amendments to the policy were approved by the Advisory Board in August 1977. None of the revisions took place in sections related to schedule adherence or service dependability.

In March 1985, a draft proposal was developed by the MBTA's Service Planning staff which, if adopted, would significantly alter the scope of the Service Policy. Briefly, the changes were intended to remedy four deficiencies identified by Service Planning in the current policy:

a.) a lack of data which would show whether current bus service meets Policy standards;

b.) objectives which, when complied with, conflict with each other;

c.) an overly ambitious scope; and,

d.) insufficient guidance to help Service Planning deal with substandard services.

A full text of the draft proposal is shown in Appendix A. Since its preparation in March 1985, the draft changes to the Service Policy have been circulated for review by various department heads as well as the Advisory Board. Further advancement of the proposal is presently awaiting approval by the Director of Operations. Thus, the 1977 version of the Service Policy remains as management's formal statement of performance standards for bus and local streetcar service.

2.2.2 The Service Committee

Section 5.1.2 of the Service Policy institutionalized the role of the Service Committee, a body which had been in existence since the early 1970s. The Committee includes MBTA representatives of Service Planning, Operations Planning, Plans and Schedules, Transportation, Budget and Operations Analysis and MIS. The original purpose of the Service Committee was to evaluate service proposals against the design guidelines prescribed by various management policies. The adoption of the Service Policy strengthened that function by solidifying disparate standards for service planning and added a new function of evaluating the performance of service already in operation.

2.3 MBTA Standards for Schedule Adherence

Section 4.2 of the Service Policy defines operating performance standards for the MBTA's non-express service (i.e. bus, trackless trolley and local surface streetcar). Measures of reliability include average speed, recovery time, load factors, wait time for vehicles, labor productivity, schedule adherence, service dependability and complaints.

MBTA standards for schedule adherence center primarily on departure times from terminal points, although the policy prescribes that intermediate time data be used as well. Section 4.2.5 reads as follows:

a.) "Leave" times at the terminal points of a route will be exact. Approximate "leave" times will be determined at intermediate points (i.e., major street intersections and activity centers) along a route.

b.) No trip will leave a terminal point ahead of the scheduled "leave" time.

c.) Table 4.2C shows the schedule adherence standards for all service types and functions at route terminal points. "On time" is defined as 0 to 5 minutes late.

Table 4.2C

Minimum Percent of Service On-Time
Bus, Trackless Trolley and Surface Streetcar Services

Time Period	Headway		
	Less than 10 minutes	10 to 30 minutes	Over 30 minutes
Peak Period	80%	95%	95%
Midday/Evenings	80%	95%	95%

There are two factors which limit the usefulness of the MBTA's schedule adherence standards: a.) a lack of data collection capability and b.) "on-time" is based on departure rather than arrival times. A 1982 study of management practices at the MBTA underscored the need for more up to date data as a tool in making service decisions. The study recommended increased staffing levels in both the Service Plan-

ning and Scheduling units.[5] No apparent action has been taken on those recommendations in the intervening years. As a result, the MBTA currently lacks the manpower to collect and analyze data measuring on-time performance.

The disregard of arrival time as a key performance benchmark and the failure to establish intermediate "leave" times as mentioned in Section 4.2.5 of Service Policy deprive both bus operators and their supervisors of important tools. Lack of these and other resources makes effective field supervision and progressive self-assessment by bus operators difficult.

2.4 MBTA Standards for Service Dependability

Section 4.2.6 of the Service Policy describes MBTA standards for service dependability. The section reads as follows:

> a.) Maintenance standards will be high enough to provide, at a minimum, 10,000 revenue miles of service for each disruption of service due to mechanical failure.
>
> b.) 99.9% of all scheduled trips will be completed each quarter.
>
> c.) When a lack of manpower will result in trips being lost, preference will be given to routes having headways of 30 minutes or greater or having spot-scheduled trips.

The major deficiencies in Section 4.2.6 seem to be ones of omission. The section implicitly assumes that a high level of dependability will be achieved if delivered service meets each of the standards. However, even if each dependability standard was strictly adhered to, service as delivered could still be considered undepend-

5 - Touche Ross and Company, "Comparison of Staffing and Expenditure Levels and the Organization Structure for Four Departments with Other Systems," excerpt from Management Practices Study, Massachusetts Bay Transportation Authority, October 29, 1982.

able by patrons because the standards fail to include measures which reflect service performance as seen by passengers. Key measures not currently used include headway variability and passenger wait time for vehicles. To illustrate, extreme headway variability can exist even if 100% of scheduled trips are operated and 10,000 miles are operated between mechanical failure. Additional problems with Section 4.2.6 underscore the need for revision of the whole section:

4.2.6 (a) - Maintenance: In recent years the MBTA has been collecting precise mileage data which enables it to compute miles between failure (MBF) ratios. The MBTA has been operating, on average, considerably fewer than 10,000 miles between failure, although current MBF levels have consistently exceeded the national average. During 1983, the last year for which comparative figures are available, MBTA buses averaged 2,171 miles between failure, compared to the national average of 1,745 MBF.[6]

When the Service Policy was being formulated, it is possible that insufficient data was available to determine a reasonable ratio for revenue miles between failure or what constituted a "failure." However, current MBF goals are considered by Automotive Equipment Maintenance Department officials to be both accurate and attainable.

4.2.6 (c) - Preferential Treatment of Routes: MBTA Transportation Department officials acknowledge the importance of giving preference to wide headway routes when resources need spot reallocation. How-

6 - Lyons, William M., et al, National Urban Mass Transportation Statistics, FY 1983, Transportation Systems Center, UMTA Report UMTA-MA-06-0107-85-1, (December 1984).

ever, records documenting whether the MBTA adheres to this standard are not maintained.

2.5 Adherence to the MBTA Service Policy

In general, the Service Committee abides by policy standards relating to service design. When faced with a proposal for new service, the Committee combines a flexible implementation of the general tenets of the Service Policy with input from various departments in making its recommendations. MBTA officials generally agree that in this role the Service Committee has been successful in balancing vehicle, manpower and funding resources.

On the other hand, the Committee does not regularly review and evaluate existing service. Though the Committee has been an active participant in the corridor studies which are looking at bus service in each sector of the MBTA District, the Committee did not previous to the studies and still does not have plans to review service at set intervals. And even during the corridor studies, consistent application of Service Policy standards was (is) not evident.

In addition, since 1977 management priorities for service related data have changed, rendering less important some measures while introducing others such as rail line throughput. As was previously illustrated, use of the Service Policy as a means of evaluating current service performance has been limited. The planned introduction of automated vehicle monitoring (AVM) technology (see Section 5.4) will likely further alter the role of the current Service Policy in the monitoring and evaluation of performance.

MBTA officials openly acknowledge that the current Service Policy is not well suited to the current operation and needs to be redesigned. In addition, change/reorganization of the MBTA's Service Policy is important in order to avoid the perception of random or selective adherence to standards. In the past there have been occasions when evidence has indicated the T has practiced the selective enforcement of the Service Policy as a means of rationalizing predetermined ends. For example, during the budget crisis years of 1978-1981, MBTA management decisions on service cutbacks were seen as arbitrarily made and then justified using only those criteria which made routes chosen for discontinuance look particularly inefficient.

CHAPTER 3: CURRENT MBTA BUS SERVICE PERFORMANCE

3.1 Currently Used MBTA Performance Indicators

Currently, MBTA weekday bus service performance is measured by four standards: missed trips, vehicle availability at the start of the service day, in-service vehicle failures and bus roadcalls. Performance data for weekend service is not presently collected. Data is compiled and reported in aggregate form by each of the eight garages. Summary figures for each weekday are grouped into the Daily Service Report and circulated to various departments and outside agencies. An example of the bus portion of the Daily Service Report is shown in Appendix B.

The T's only reported measure of bus service output is the percentage of scheduled weekday trips operated. The causes of missed or "dropped" trips are disaggregated into four broad groups: unavailable vehicle, vehicle failure, operator not available and miscellaneous.

3.1.1 Advisory Board Standard

In 1976, the MBTA and its Advisory Board agreed, in principle, to a service standard which set 98% as a satisfactory level of scheduled trips operated. Adoption of the 98% standard was a good start at evaluating service performance, however, missed trips do not give a total picture indicative of service delivery and reliability. The disadvantage of using an across-the-board standard, such as the 2% standard for missed trips, is that it assumes an equal overall impact.

The relative effect of missed trips varies according to the type of route, the headway at the time of the missed trip, the passenger density and the skill of supervisory personnel at balancing resources in response to service disruptions.

3.2 1985 Missed MBTA Bus Trips

There were indications during 1985 that, even with a slight increase in the number and percentage of missed trips, MBTA personnel have improved their ability to make effective spot adjustments to service. Total scheduled and missed bus trips for the calendar years 1976 to 1985 are shown in Table I. The table illustrates a recent trend of fewer missed scheduled trips. A tremendous backlog of vehicles awaiting maintenance, along with a rift in labor/management relations, precipitated the surge of missed trips during the years

TABLE I

MBTA BUS SERVICE PERFORMANCE 1976-1985
(Includes Trackless Trolley Service)

YEAR	WEEKDAY ROUND-TRIPS SCHEDULED	WEEKDAY BUS TRIPS MISSED	PERCENT OF SCHEDULED TRIPS MISSED
1985	1,688,861	21,197	1.26%
1984	1,686,709	17,556	1.04%
1983	1,689,147	20,692	1.22%
1982	1,669,071	42,439	2.54%
1981	1,875,575	50,751	2.71%
1980	2,045,022	44,594	2.18%
1979	1,974,874	85,339	4.32%
1978	1,960,780	36,741	1.87%
1977	1,854,105	28,185	1.52%
1976	2,018,738	22,809	1.13%

1979 through 1982. A general improvement in both maintenance prac-

tices and employee morale has helped bring a decline in the number and percentage of scheduled bus trips missed.

For the past three years, the percentage of scheduled bus trips missed has remained within the Advisory Board/MBTA 2% missed trip standard. In addition, since 1980 vehicle availability has steadily increased such that during 1985 there were virtually no missed trips due to unavailable buses.

3.2.1 Performance Levels at Each Garage

Performance levels among the eight bus garages vary greatly depending on the predominant type of service operated (i.e., high-speed suburban, high-density local, etc.) and the strength of management initiatives to control vehicle and crew availability. The tables in Appendix C outline the service area and the percentage of scheduled trips missed for each garage. Two suburban bus rating stations, Quincy and Lynn, have traditionally operated the highest percentage of scheduled trips. Routes based at both Quincy and Lynn are generally longer with greater distances between stops than the systemwide average. By contrast, the service operated from Bartlett, Cabot and Charlestown Garages is predominantly high-frequency urban local service which, while accumulating fewer miles on buses, presents a maintenance scenario equally challenging to Automotive Equipment Maintenance (AEM) mechanics.

Analysis of the missed trips data for 1985 shows that special operating problems exist at both Bartlett and Cabot Garages. Supporting 16% of the MBTA's weekday bus operation, Bartlett routes experienced 26% of the total number of missed bus trips. Cabot, with 22% of

the T's bus service, posted 37% of total missed trips.

Causes of missed trips vary among the eight garages. For example, vehicle-related problems were the cause of 76% of the missed trips at Lynn, but only 31% at North Cambridge. Similarly, crew problems caused the greatest percentage of missed trips at North Cambridge. Absolute numbers tell a different story. Cabot Garage generated more than half of the total crew-related missed bus trips yet it supports only one-fifth of the MBTA's bus operation. A breakdown of the cause of missed trips is shown in Appendix D.

3.3 The MBTA Consumer and Reliability

To fill in the missing picture (beyond missed trips) and to get a better idea of just how well served T bus patrons are, an Advisory Board Study Team set up and implemented a survey of actual bus headway variability on a cross section of MBTA routes. Observations and conclusions follow.

3.4 Selection of MBTA Test Bus Routes and Measures

Routes which were representative of all MBTA bus routes (i.e., local, express, etc.) and served a wide cross section of communities were selected for direct observation. Data collection points were chosen based on the number of routes passing each point and the frequency of service along those routes. Appendix E lists the routes studied and the number of weekday trips scheduled along each route. Total weekday trips scheduled along the test routes represent more than 25% of the MBTA's weekday bus trips.

3.4.1 Data Collection Points

Table II lists the seven locations which were selected as data collection points and the number of routes serving each point.

TABLE II

DATA COLLECTION POINTS

Location	Routes
Roslindale Square (Washington Street @ South)	10
Central Square, Waltham (Railroad Station)	5
Brookline Village (Cypress Street @ Rte. 9)	3
Porter Square, Cambridge (Station Plaza)	8
Davis Square, Somerville	5
Medford Square (Main Street @ High)	5
Malden Center Station (East Busway)	14

Consideration was given to the geographical range of the routes in terms of the number of District cities and towns served. The location of each collection point is illustrated in Appendix F. Table III lists the cities and towns served by the test routes chosen. Nearly 35% of the cities and towns in the MBTA District are served by the test routes selected. Sixty-one percent of the MBTA District population resides in the communities served by the test routes. The proportion of MBTA riders served by the test routes could not be included because ridership data is not routinely collected. Appendix G shows the cities and towns in the study area.

3.4.2 Type of Data Collected

At each collection point weather conditions, the passing time of each vehicle and any unusual incidents or conditions which might skew the data were noted. Data collection took place between April and

TABLE III

CITIES AND TOWNS SERVED BY TEST ROUTES

Arlington	Newton
Bedford	Norwood
Belmont	Reading
Boston	Revere
Brookline	Saugus
Burlington	Somerville
Cambridge	Wakefield
Chelsea	Walpole
Dedham	Waltham
Everett	Watertown
Lexington	Westwood
Malden	Winchester
Medford	Woburn
Melrose	

July 1985 (Spring and Summer 1985 timetables) and included one morning and one evening peak period as well as one midday period at each location for each route. Summary results for each route are shown in Appendix H. The mean observed headway (time between successive trips), headway dispersion (standard deviation) and observed passenger wait time were then calculated. A sample calculation sheet is shown in Appendix H.

3.4.3 Methodology

One of the major recommendations of the 1979 UMTA Service Reliability Study was to use the standard deviation of observed headways as the measure of service variability along particular routes. For comparisons, the study recommended using the coefficient of variation, or covariance, of headway for groups of routes. The covariance of headway, a measure of trip time uniformity, measures headway variability as a percentage of the mean headway.

Accordingly, a route with a mean headway of 60 minutes and an observed standard deviation of 24 minutes - extremely variable - would be considered as unreliable (covariance of headway=40%) as a route with 15 minute headways and a standard deviation of six minutes.

TABLE IV

SENSITIVITY CALCULATIONS - COVARIANCE OF HEADWAY

		STANDARD DEVIATION (minutes)						
		1.00	2.00	5.00	7.50	10.00	15.00	20.00
MEAN HEADWAY (min)	MEAN WAIT TIME (min)	COVARIANCE OF HEADWAY (%)						
								UNRELIABLE
4.00	2.00	25.00	50.00	125.00	187.50	250.00	375.00	500.00
6.00	3.00	16.67	33.33	83.33	125.00	166.67	250.00	333.33
8.00	4.00	12.50	25.00	62.50	93.75	125.00	187.50	250.00
10.00	5.00	10.00	20.00	50.00	75.00	100.00	150.00	200.00
15.00	7.50	6.67	13.33	33.33	50.00	66.67	100.00	133.33
20.00	10.00	5.00	10.00	25.00	37.50	50.00	75.00	100.00
25.00	12.50	4.00	8.00	20.00	30.00	40.00	60.00	80.00
30.00	15.00	3.33	6.67	16.67	25.00	33.33	50.00	66.67
35.00	17.50	2.86	5.71	14.29	21.43	28.57	42.86	57.14
40.00	20.00	2.50	5.00	12.50	18.75	25.00	37.50	50.00
45.00	22.50	2.22	4.44	11.11	16.67	22.22	33.33	44.44
50.00	25.00	2.00	4.00	10.00	15.00	20.00	30.00	40.00
55.00	27.50	1.82	3.64	9.09	13.64	18.18	27.27	36.36
60.00	30.00	1.67	3.33	8.33	12.50	16.67	25.00	33.33
		RELIABLE						

Table IV illustrates the relationship among mean headway, mean wait time and various standard deviations and covariances. Note that for headways of less than ten minutes variability is great with even a small standard deviation. For this reason, and because passengers do not feel the same frustration with variability on high frequency routes, we have sorted results by frequency of headway to highlight

the variations which most likely have greatest impact on riders.

The absence of intermediate point or terminal arrival time data further supported use of the covariance of headway as our principle measure of MBTA bus service reliability. In addition to the covariance of headway, variations in observed headway and passenger wait times were also measured.

UMTA's Minneapolis-St. Paul report established that passengers would perceive service to be unreliable when the variability of headway as measured by the standard deviation exceeded 50% of the expected wait time for a vehicle. Expected wait time was defined as one-half of the scheduled headway.[7] Thus, service was termed unreliable when headway dispersion expressed as a percentage of mean observed headway exceeded 25% of the mean headway.

To illustrate, randomly arriving passengers at a stop on a route with 30 minute scheduled headways can expect to wait an average 15 minutes for their bus. If the covariance of headway was 25%, passengers would likely experience wait times ranging between seven and 25 minutes. Most passengers would consider service to be unreliable if they arrived at a set time each day and were required to wait 25 minutes for the bus to arrive on one day, seven minutes the next and only ten minutes on other days.

7 - Wilson, Nigel et al., Traffic and Transit Operations on Massachusetts Avenue - Cambridge, Massachusetts: Analysis and Design, Massachusetts Institute of Technology, School of Engineering (May 1979) pp. 87-88.

3.5 Field Study Results

Analysis found that when measured by covariance of headway, 42% of MBTA bus services tested were unreliable, having a covariance of headway of 25% or more. Furthermore, 15% of service could be considered extremely unreliable - with a covariance of headway of 40% or greater. Table V shows the frequency distribution for covariance of headway for each category of service tested.

TABLE V

FREQUENCY DISTRIBUTION-COVARIANCE OF HEADWAY

CATEGORY	COVARIANCE OF HEADWAY (%) RELIABLE 0-10	10-25	UNRELIABLE 25-40	40+
All Service Tested	29.1%	29.1%	27.2%	14.6%
AM Peak Period Service	18.6%	27.9%	34.9%	18.6%
PM Peak Period Service	21.2%	32.9%	25.9%	20.0%
Off-Peak Service	48.2%	26.5%	20.5%	4.8%
At Terminal Points	45.2%	21.4%	23.8%	9.5%
Supervised Terminals	58.3%	12.5%	29.2%	.0%
Non-Supervised Terminals	27.8%	33.3%	16.7%	22.2%
At Intermediate Points	25.9%	30.7%	27.8%	15.6%

3.5.1 Peak Period Service vs. Off-Peak

Analysis indicates that peak period bus service is significantly more unreliable than off-peak service. Approximately half of the morning and evening peak period service tested produced a covariance of headway in excess of 25% compared to less than one-quarter of the off-peak service. Conversely, it was found that only 20% of the peak period service tested could be considered reliable (a covariance of 0

to 10) compared to almost half of the off-peak service.

The peak/off-peak variation is also seen in the time passengers must wait for buses. The percentage variance of actual versus expected passenger wait time for buses was less during off-peak hours than during morning and evening peak periods. Increased vehicular and passenger traffic during peak hours and the failure to regularly update and adjust scheduled travel times probably accounts for most of the gap between peak and off-peak service.

3.5.2 Close vs. Wide Headway Service

What does the failure of T buses to run with precision mean for the person on the street? Where headways are ten minutes or less a covariance of 25 to 40 may go unnoticed by the occasional rider and be a petty annoyance to the regular commuter. But on routes with headways of 20 minutes or more, such variation becomes a key factor in decisions to ride or not ride public transportation.

Table VI shows the frequency distribution of the covariance of headway for various headway ranges. The data in Table VI indicates that routes with high frequency service tended to be more highly variable than routes with wide headways. Although variability appears to be extremely high on routes with headways of less than ten minutes, passengers on routes with high frequency service are less likely to perceive headway variability than passengers on routes with wide headways. Routes with headways of between 30 and 50 minutes (28% of those tested) posted the highest frequency of reliable service. Thus while you would not want to set a watch by most MBTA bus service, it

TABLE VI

FREQUENCY DISTRIBUTION-COVARIANCE OF HEADWAY

HEADWAY	% OF ROUTES TESTED	COVARIANCE OF HEADWAY (%) RELIABLE 0-10	10-25	UNRELIABLE 25-40	40+
Less than 10 minutes	7.5%	.0%	.0%	36.8%	63.2%
10 minutes and less than 20	27.6%	4.3%	31.4%	42.9%	21.4%
20 minutes and less than 30	21.6%	21.8%	36.4%	29.1%	12.7%
30 minutes and less than 50	27.6%	54.3%	25.7%	17.1%	2.9%
50 minutes and more	15.7%	52.5%	35.0%	10.0%	2.5%

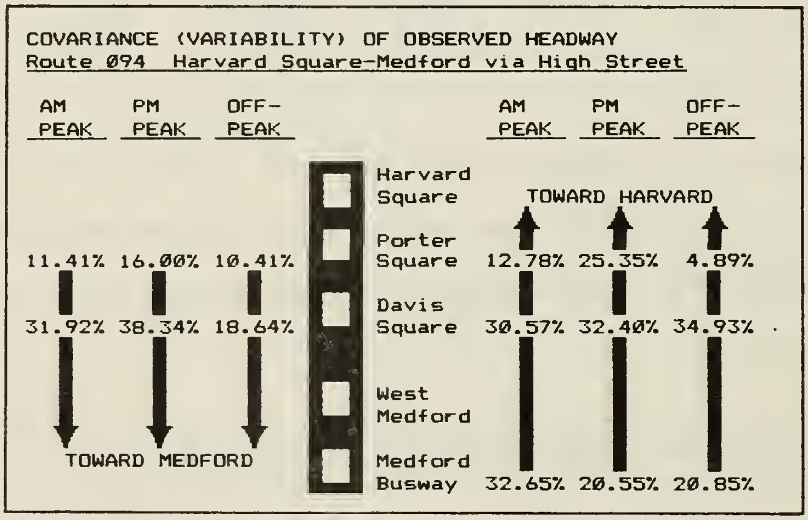
is the routes with headways of 20 minutes or more and covariances of headway of 25% or greater that cause significant problems for passengers. These are the routes where control of variance should be a priority.

3.5.3 The Effects of Supervision on Variability

Analysis of the headway data suggested that the level of field supervision affects MBTA service reliability - a phenomenon also observed in UMTA's Minneapolis project. According to our data, MBTA bus service departing from non-supervised terminals is more unreliable than bus service monitored at control points by an Inspector. Nearly 60% of the service measured at supervised terminal points had a covariance of headway of 10% or less. On the other hand, only 28% of the service measured at non-supervised origin points had a similar covariance.

The variability of vehicle headways tended to decrease along the route in the direction of travel toward supervised control points.

Along the routes tested, variability usually increased toward the midpoint of the route and tended to continue increasing in the direction of travel toward non-supervised terminal points. A likely explanation is that drivers tend to be more aware of their on-time performance when they are approaching known points of surveillance. The chart below illustrates this concept.



The contrast between service measured at terminal and intermediate points is also reflected in observed passenger wait time. Wait time variance (observed vs. expected) of 5% or less was recorded in 62% of terminal point test cases but in only 39% of the intermediate point test cases. This means that passengers waiting at locations along the route other than terminal points are more likely than their counterparts at terminal points to experience wait times in excess of one-half of the scheduled headway.

CHAPTER 4: MBTA SCHEDULE-MAKING

4.1 The Significance of Schedules

The MBTA's product is passenger transportation service. Schedules are the vehicle for delivering that service. Schedules should insure that the proper supply of service is provided given the variances in demand at different times and different days of the week. When schedules meet demand and appropriate headways are able to be maintained, passengers perceive the service to be dependable. Where frequency is too low with respect to demand, or where variable headways result from poor scheduling or inefficient operating practices, crowding results and/or ridership can decline because patrons deem the service undependable.

Schedules are important to drivers because they prescribe the hours to be worked and the passenger load expected to be carried. Poorly constructed schedules can cause irregular headways resulting in a driver doing either substantially more or less than his/her fair share of work. This results in the driver either arriving late at the terminal, missing subsequent trips and causing more crowding, or working overtime and adding to the Authority's costs.

The definition of "adequate" schedules varies with the audience. In general, management would consider a schedule "adequate" if it allows service to be delivered reliably while serving the public at a reasonable cost. Drivers, in contrast, would classify a schedule as good if it included a large number of high-paying runs with long

layover times at the end of each trip. The public would consider the schedule to be adequate if service is consistent and timed to afford a wide choice of departures.

4.2 Current MBTA Schedule-Making Procedures

The MBTA's Plans and Schedules Department, a division of the Operations Directorate, is responsible for the preparation of schedules (departure times and headways). The Department is staffed by approximately 25 people including supervisors, schedule-makers, clerks and traffic checkers. Currently, the MBTA uses a manual process to construct the nearly 2,000 timetable runs (individual pieces of work comprised of several trips) necessary for its rail and bus lines. Under ideal conditions, it takes eight weeks to build schedules and cut runs.

4.2.1 Management Policy

The entire run-cutting process is governed by management policy and union work rules. Although it is not rigidly followed, the Service Policy establishes basic guidelines for the level of service to be provided. These guidelines specify load factors which in turn determine specific headways, hours of service and basic performance goals.

4.2.2 Union Work Rules

MBTA union contracts specify that four "picks" (timetable changes) take place each year. For each pick, the MBTA must construct new timetable runs for selection by drivers in order of their seniori-

ty. In constructing new schedules, schedule-makers must accommodate work rules which define platform time and spread time along with other conditions. In general, work rules are more restrictive to schedules than policy guidelines.

4.2.3 Line Characteristics

In addition to the work rules and policy guidelines, timetables must reflect the characteristics of each line (i.e., peak or off-peak operation, traffic conditions and running time). Tools used by schedule-makers include traffic counts, boarding counts at specific stops, route profiles and running times. Most data is collected manually by checkers assigned to Plans and Schedules, although only on an infrequent, as-needed basis. Data collected as part of various corridor studies has recently been added to this data base.

4.2.4 Automated Systems

The 1982 MBTA Management Practices Study recommended certain changes in staff and procedures at Plans and Schedules. Foremost among the recommendations was the purchase and installation of an automated run-cutting system. After examining scheduling and run-cutting systems in use at other transit agencies, the MBTA selected Multisystems, Inc. to design and install a Transportation Control and Information System (TCIS). The $1.2 million TCIS contract was approved by the MBTA Board of Directors in July 1985 and the system is expected to be fully operational by the end of 1987.

There are four elements to the TCIS system: planning, scheduling, run-cutting and management reports. The TCIS planning subsystem, an

enhanced version of UMTA's Transit Information Manager (TIM) which is already in use at the MBTA, will maintain a database containing ridership data and route profiles. The scheduling subsystem will develop vehicle schedules based on scheduled departure and running times.

The run-cutting subsystem will allow the MBTA to construct operator runs based on optimal operating conditions and cost. Run-cutting is the area where the MBTA hopes to save the most time. MBTA Plans and Schedules officials envision the time needed to produce timetables to be reduced from one week to one hour for each individual operating area. Surprisingly, MBTA officials do not foresee manpower savings as a result of the new system. According to Plans and Schedules Department officials, time savings will be used to construct different timetables to match different operating scenarios and to produce forms and reports (headway sheets and driver paddles) not already produced.

The management reports element of TCIS will provide MBTA management in each department with several different service-related statistical reports.

4.3 Schedules and Reliability

Section 4.3 provides a general outline of the elements needed to build schedules. Section 4.4 addresses each of these elements as they relate to the MBTA.

Schedules can be useful to management in monitoring and regulating the reliability of operations. The degree of usefulness depends on the level of information generated by schedules and the use of that information by management. The most important byproduct of schedule-

making is the timetable run sheet which lists individual timetable runs or pieces of work. Run sheets show blocks of work listed in order of garage pullout (the time each driver leaves the garage) and typically include only terminal departure times. A sample run sheet is shown in Appendix I.

4.3.1 Platform Time

Platform time is the total amount of time a driver and vehicle are assigned to a run - from the time a vehicle leaves the garage to pullback to the garage. Platform time includes trip time, recovery time (also known as layover time), paid meal break and pullback time. Timetable productivity can be measured by the amount of time a driver or vehicle is in revenue service. The greater the percentage of revenue service hours vs. layover time and paid break time, the more productive a timetable is.

4.3.2 Recovery Time

Time allowed for pullout, pullback and meal breaks is determined by union contract. Travel times are supplied by running time sheets and, in theory, are as close to actual as possible. Thus, recovery time becomes an important determinant of timetable efficiency. Most transit systems figure recovery time at each terminal as approximately 10% of one way travel time.

Bus service reliability depends in great part on how current and accurate the data contained in the running time sheets is. Reliability is also affected by the amount of recovery time. Because traffic congestion is inherently unpredictable, trips operated with too little

recovery time (generally less than five minutes) have a tendency to delay subsequent trips. On the other hand, excess recovery time allows for variability in headways, travel time and arrival times.

4.3.3 Headway Sheets

Terminal headway sheets, another byproduct of schedule-making, list terminal departure times for individual routes but not arrival times at either intermediate points or terminals. When used alone, terminal headway sheets are limited in their utility as a tool to improve reliability. Intermediate headway or "point" sheets show arrival times at specific points along a route. Together, headway and point sheets allow supervisory personnel to evaluate and regulate operations. Intermediate time data can be made available for public timetables. By making intermediate arrival times available to passengers, the guesswork is taken out of knowing when a bus is due at a particular point along a route.

4.3.4 Driver Paddles

Most bus transit systems provide their operators with individual run timetables or "driver paddles" which detail the itinerary and schedule for a particular piece of work. Examples of paddles are shown in Appendix O. Intermediate and terminal times built into paddles allow drivers to progressively assess their own performance along the route. They also provide a standard by which supervisors can evaluate individual drivers.

4.4 Deficiencies in MBTA Schedule-Making

Missing pieces in the MBTA's scheduling process allow unreliable

service to go unchecked. Although MBTA field supervisors are provided with terminal headway sheets, each route is listed on a separate sheet which makes it difficult to monitor and regulate headways, especially during peak periods. Except for those built specially for Inspectors working at the Heath Street Loop in Jamaica Plain, the MBTA does not regularly produce intermediate or point headway sheets.

4.4.1 Running Time

There are three factors which erode the effectiveness of the MBTA's running time sheets:

a.) running time sheets are not sufficiently detailed to account for differences in travel time during the service day;

b.) trip times found in MBTA timetables do not always reflect running time sheet data; and,

c.) trip time information is not usually updated unless a change in routing occurs.

T officials contacted expressed the opinion that trip times as shown on running time sheets do not reflect real operating conditions. Several running time sheets include only one or two trip time values to be used in constructing trips throughout the service day. In practice, mean travel time varies not only during the 20-hour service day but even from one half-hour period to the next.

Drivers surveyed expressed the need for more time to complete trips along with additional recovery time. Inspectors shared drivers sentiments, adding that running times do not always account for established patterns of increased passenger and vehicular traffic, congestion due to construction or heavy passenger loads such as when schools

let out.

In an effort to maintain "clockface" headways (i.e. on the hour or half-hour), MBTA timetables are not always constructed using trip time values shown on the running time sheets. Thus, in some instances drivers may be allowed more time than is normally required to complete a trip; other times less.

Other than when a change in routing or terminal occurs, running times are usually only updated in response to requests from District Supervisors. However, since driver input is not routinely solicited, only those routes which cause frequent driver complaints are checked for running time revisions. Thus, delays caused by long-term construction projects or newly signalized intersections are often not accounted for in allowed running times. Some running time sheets have remained unchanged for more than 10 years.

4.4.2 Recovery Time

Section 4.2.2 of the Service Policy describes standards for recovery time:

a.) Any service having a layover time to running time ratio greater than 20% for the time period being analyzed must be investigated for cause.

b.) No service, under any circumstances, is to have a layover time to running time ratio greater than 30% at any time.

An analysis of ten randomly selected timetable runs (involving 119 one-way trips) from the Spring 1985 timetable showed that 61% of the trips had layover time to running time ratios of 20% or more. Thirty-three percent of the trips had layover/running time ratios of

30% or more. In fact, all of the runs selected had average layover/running time ratios which exceeded 20%. The test runs selected included full and part-time runs involving peak and off-peak trips. Results are shown in Appendix I.

4.4.3 Driver Information

MBTA bus drivers are not provided with paddles showing arrival times at either intermediate points or terminals. In fact, most drivers are unaware of allowed one-way trip times (from the running time sheets) and, as a result, are unable to provide their passengers with accurate arrival or connecting time information. Drivers who are assigned to the cover list fill in for others who are either late or otherwise unable to complete their trips. In several instances witnessed by the study team, cover list drivers were unfamiliar with the route, schedule or fare structure of their assignments. Paddles, had they been available, might have prevented such occurrences.

4.4.4 Schedules and Passenger's Perception of Reliability

Predictability of arrival time is a passenger's most important measure of reliability. Each element of schedule-making, from accurate running time data to the availability of detailed schedule information to drivers and passengers, affects headway variability and thus the reliability of service. The combination of inaccurate running times, excessive recovery time and the general lack of schedule information to MBTA employees and passengers has helped to establish a pattern of unpredictable arrival times.

CHAPTER 5: FIELD SUPERVISION OF BUS OPERATIONS

Transit systems monitor and enforce schedules using various techniques of field supervision. Field supervision of in-service resources represents one of the last opportunities for management to control transit service according to previously set operating standards and policy. Generally, transit operators use one or more of four primary techniques of field supervision: line supervision, district supervision, control by radio communication and automatic vehicle monitoring (AVM) systems or devices. Sections 5.1 through 5.4 describe the various techniques. Section 5.5 evaluates the MBTA's field supervisory practices. It should be noted that local operating environment and management philosophy significantly influence the strategy or combination of strategies used as well as their effectiveness.

5.1 Line Supervision

With line supervision, individual supervisors are assigned a specific route or group of routes to monitor and control. Line supervisors may be assigned a portable two-way radio or use the telephone to communicate with a central base control station. In either case, maintaining open communication links with central control is essential to the line supervisor's duty. Through these links, line supervisors can be informed of incidents that may occur along his/her assigned routes.

Line supervisors position themselves at a point along the route or among the routes which facilitates regulation of service. When common intersection points exist, such as rapid transit stations or activity centers, a single line supervisor can monitor many converging routes. However, in some cases line supervision is more effective when the supervisors are mobile, roaming from one point to another either on foot or by bus. Line supervisors who move along a route can make random spot checks and thus can exercise greater influence on service performance than those supervisors stationed at one point.

When service disruptions occur, line supervisors restore normal headways by spacing vehicles, short-turning trips, inserting extra vehicles or changing drivers. Line supervision involves careful record-keeping. At most transit agencies, line supervisors submit daily reports documenting the day's operations, providing details of disruptions, delays, accidents or vehicle failures. The supervisor records all remedial action.

The success of line supervisors in regulating service depends in great part on good judgement, adequate training and experience. Some line supervisors also perform the functions of traffic checkers by periodically taking loading counts and time checks for later use by management.

5.2 District Supervision

Mobile or "district" supervisors perform a function similar to that of a line supervisor, except that the area of coverage and degree of responsibility is generally greater. To patrol routes in their districts, supervisors are provided with radio-equipped vehicles.

District supervisors are usually the first to be dispatched to the scene of a breakdown or accident. Thus, they are often trained in troubleshooting and carry tools and emergency equipment in their vehicles.

Responsibility for monitoring the performance of operators, including both schedule adherence and driving habits, is usually that of the district supervisor. In the event of accidents or other major service disruptions, the district supervisor arranges for additional vehicles and drivers and diverts service around the disruption.

5.3 Radio Communication

Most transit operators utilize some form of radio communications between vehicles and a central control base station. With radio control, contact may be via voice or digital transmission. Smaller bus operators use radio systems for both incident-handling and schedule adherence purposes. As this is impractical on larger systems, radios are used primarily for emergency purposes. Large operators usually decentralize their radio communications at either the district or garage level.

Although radio systems have permitted transit agencies to reduce the manpower necessary for field supervision, radio supervisors still must rely on field supervisors and drivers to report occurrences which have the potential to disrupt service. Moreover, radios cannot enforce management directives with regard to driving habits, driver appearance or fare policy. However, radios can reduce the time necessary to respond to accidents and permit drivers to be simultaneously

warned of potential traffic bottlenecks.

5.4 Automated Vehicle Monitoring

In the past decade, progress has been made in the development of AVM systems. Under the AVM concept, a microprocessor on board each vehicle collects data from various sensors. The data can relay information on vehicle location, passenger loads and mechanical conditions. The information is collected by a central computer and displayed on monitors at a central control base. This allows supervisors to monitor bus location, loading characteristics and schedule adherence. Some systems are capable of comparing actual and scheduled location for each bus and automatically relaying this information to both the dispatcher and driver.

AVM systems are capable of producing detailed management reports on ridership and operating characteristics of individual drivers, vehicles and routes. This information may include driver performance records, vehicle breakdown data, actual running times, schedule deviation, missed trips and mileage and ridership counts (if the vehicles are equipped with passenger count sensors). Such data allows schedules to more closely match actual operating conditions. A particularly well integrated AVM system has been installed by Metro Transit in Halifax, Nova Scotia and is outlined in Appendix S.

Though most recent AVM systems have been installed at larger transit properties, advances in AVM technology have considerably reduced the expense of procurement and installation allowing smaller systems to consider AVMs.

5.5 MBTA Field Supervision

Field supervision of MBTA bus operations is provided by 125 Inspectors (formerly called Starters) and 27 Chief Inspectors. On weekdays, Inspectors are assigned to one of 46 separate locations, most of which are at high passenger volume rapid transit stations. They monitor the flow of bus service to and from their posts and assist operators and passengers. Inspectors are required to report delays and other problems along with their cause to the Central Control Dispatcher. If necessary, Inspectors make spot mechanical repairs in an effort to keep vehicles in revenue service. For the Fall 1985 timetable, MBTA Inspectors were scheduled to provide 764 man-hours of coverage per weekday.

Each of the six MBTA bus [seniority] rating stations employs at least one Chief Inspector who oversees the performance of the Inspectors. In contrast to stationary Inspectors, Chief Inspectors are mobile supervisors who patrol their districts using radio-equipped vans. Occasional spot-checks of individual bus operators are also carried out by Chief Inspectors, but usually only in response to complaints about an individual. The MBTA does not employ line or route supervisors whose area of coverage is specific to particular routes. Aside from the dispatchers and supervisory personnel located at Central Control, the MBTA does not assign field personnel whose sole responsibility is to monitor and regulate headways.

Surface Inspectors and Chief Inspectors are expected to be thoroughly familiar with the MBTA's transportation network, building on knowledge and skills gained while employed as bus or streetcar opera-

tors. According to information provided by the Operations Directorate, functions performed by Inspectors and Chief Inspectors focus on public safety. In fact, the T's Inspectors and Chief Inspectors are licensed as Street Railway Police Officers, a unique phenomenon in the transit industry. The Operations Directorate's detailed response appears in Appendix J.

Considerable resources are aimed at training Inspectors and Chief Inspectors in their security duties. Each is required to undergo a three week training program and annual five-day retraining program to certify them as Street Railway Police Officers. According to information supplied by the Training Division, the annual retraining program includes both classroom and field work in the following areas:

- Investigative report writing
- Persuasion devices and handcuffs
- Fire prevention and protection
- Equipment familiarization
- Overcoming mechanical problems
- Emergency procedures
- Vehicle evacuation
- Bus circle checks
- Handling accidents
- Cardiopulminary resucitation
- Office practices and terminology
- Industrial accidents and reports

5.6 Industry Survey

As part of this study, we surveyed seventy-five of the largest bus transit operators in the United States and Canada about their methods of field supervision. A list of the agencies surveyed is shown in Appendix K. Forty, or 52% of the systems surveyed, responded to our survey. Half could be considered large bus fleet operators (with 500 or more peak-hour vehicles in operation). Seven of the 40

respondents were Canadian properties. Table VII shows results from this survey. Appendix K contains several of the more descriptive responses.

TABLE VII

FIELD SUPERVISION OF BUS OPERATIONS-SURVEY RESULTS

	ALL RESPONDENTS	MBTA	LARGE FLEETS	SMALL FLEETS
Full & Part-Time Point Supervision:	47.5%	Yes	70.0%	25.0%
Part-Time Point Supervision Only:	47.5%	No	30.0%	65.0%
Roving Mobile Supervision:	100.0%	Yes	100.0%	100.0%
Regular On-Time Checks at Terminals:	100.0%	No	100.0%	100.0%
Regular Intermediate On-Time Checks:	57.5%	No	70.0%	45.0%
Entire Bus Fleet Radio-Equipped:	95.0%	No	95.0%	95.0%
Driver Habits Routinely Monitored:	97.5%	No	95.0%	100.0%
Automatic vehicle Monitoring in Use:	32.5%	No	40.0%	25.0%

In reviewing the responses, we found that the MBTA is similar to most large bus operators in that it has both full and part-time supervision of bus operations at major terminals and mobile supervision. However, unlike most of the respondents, the MBTA does not make regular on-time checks of vehicle arrival times either at terminals or at intermediate points, nor does it make regular observances of operator driving habits. Exacerbating matters, MBTA buses are not radio-equipped on a fleet-wide basis.

One of the most important differences between the MBTA and its industry peers is that no single department or position at the MBTA is assigned the sole responsibility of maintaining schedule adherence. Limited service regulation is performed by Inspectors and Chief

Inspectors with the help of Central Control Dispatchers and, to a very small extent, by drivers themselves.

5.7 Field Observation of MBTA Personnel

Observation of MBTA drivers, Inspectors and Chief Inspectors assigned to bus service pointed out weaknesses in the system which compromises their ability to monitor and regulate headways. Our examination pinpointed two key concerns:

a.) the level of training these personnel receive; and,

b.) the availability of tools for them to perform their jobs.

5.7.1 Field Supervision and the Policing Role

At first glance, MBTA field supervisory personnel appear to play a role adjunctive to that of the MBTA Police. In 1983, the MBTA began a three week training program for Inspectors and Chief Inspectors. The program was prompted by requests from first-line managers to be better trained in handling security-related incidents and by the Governor as part of his overall plan for reducing crime on the MBTA. During the training program, each Inspector and Chief Inspector is commissioned as a Street Railway Police Officer. Their effect on transit crime has not been independently confirmed.

5.7.2 Recertification Program

In 1984, the MBTA's Safety and Training Division instituted an annual one week recertification program for Inspectors and Chief Inspectors. The program was developed using suggestions and recommendations from supervisors who had attended the previous years

three week session and from instructors who managed each training module. The overall objective was to recertify field personnel in security functions and to fulfill all previously unmet needs.

An evaluation of the recertification program, released by the MBTA in April 1985, suggested that Inspectors and Chief Inspectors were, for the most part, satisfied with the quality and content of the session. However, the report also illustrated that they face problems communicating with and receiving feedback from middle management officials. Inspectors and Chief Inspectors cite this "one-way" communication as the major obstacle hindering their performance. A portion of the MBTA evaluation is shown in Appendix L.

5.7.3 Field Personnel Interview Findings

To evaluate the effectiveness of MBTA field personnel in regulating headways, we interviewed and observed the work routine of several surface Inspectors and Chief Inspectors. We conclude that these key personnel suffer from:

a.) a lack of direction and definition in terms of their intended role;

b.) a perception of little support or cooperation from management; and,

c.) lack of necessary tools and equipment to perform their jobs.

5.7.4 Problems with Role Definition

An example of the problem of role definition is the evolution of the role of field personnel from a solely transportation related function to one more intrinsically involved with security. Because

increasing public safety was one of the principal goals of both the training and recertification programs, most of the training modules were devoted to teaching control/restraint procedures. Of the Chief Inspector/Inspector Training Program's 15 day run, only three and-one-half hours are devoted to day-to-day managerial tasks (cf. Appendix L). Regulation of schedule adherence comprises just one-quarter or roughly 45 minutes of that period. The recertification program devotes a similar portion of time to headway maintenance. In general, despite the dedication of significant training resources toward their security function, MBTA Police and Transportation Department officials still view the role of Inspectors as primarily transportation related. This has created problems of jurisdiction between Inspectors/Chief Inspectors and the MBTA Police force.

5.7.5 The 1986 Recertification Program

The 1986 Inspector/Chief Inspector recertification program was held during June and July. Several changes were made to the program. Most important, the duration of the recertification program was shortened (at the suggestion of Local 600 leadership) from five days to three. In addition, the training modules have been redesigned to place even more emphasis on security and less on regulation of transportation. One noteworthy change was the addition of a stress management module.

5.7.6 Management Awareness of the Problem

Though there are no formal procedures for first-line supervisors to communicate their suggestions to management, we found a generally high level of management concern and interest in the challenges facing

Inspectors and Chief Inspectors. Still, MBTA officials openly admit that there are frequent problems involving definition of role and interpretation of management directives by first line supervisors. Training Division officials intend to address these issues through the addition of a one time "round-table" discussion between Inspectors/ Chief Inspectors and their respective District Superintendents as part of the 1986 recertification program.

5.7.7 Lack of Tools for Job Performance

A common concern among field personnel, including vehicle operators, is that they do not possess the proper tools to perform their jobs. Ultimately, the performance of a particular route or trip is the responsibility of the driver. MBTA bus drivers are required to maintain headways and be on-time. However, they are given little or no information about expected arrival times, especially at intermediate points, making them unable to progressively self-assess their performance. Driver work assignments, or timetable runs, show only departure times at terminals (cf. Appendix I).

Although they face disciplinary action by supervisors when sufficiently late to miss subsequent trips - an infrequent event - drivers must constantly face passengers angry at the perception that their particular trip is late. To avoid this situation and to confront the issue of proper supervision as well as support driver morale, it is necessary that drivers, their supervisors and riders share common information on expected arrival times.

Inspectors, who are responsible for monitoring and regulating

service, lack key informational tools to perform their jobs. We found their dedication and performance to be very good considering what little they had to work with.

Inspectors based at most major terminals are given terminal headway sheets which list bus departure times in chronological order for routes which originate at that terminal. The times are listed on separate sheets for each route. With this basic tool, they can easily monitor originating service, but not routes which pass.

For example, the Inspector based at Malden Center Busway can easily monitor and regulate service on the #104 Sullivan and #131 East Side routes as they are scheduled to begin there. However, regulation of the #99 Upper Highland-Wellington and #106 Lebanon-Wellington routes, which pass through Malden Center, is done almost entirely by intuition - by the Inspector knowing how often the service runs, where to look (#99 does not enter the busway) and, in general, how reliably they operate. Such a task is done more easily by senior, experienced personnel. However, as we observed at Malden, most Inspectors choose to ignore routes which do not originate at their station under the assumption that "the man at the end of the line will cover for me." As a result of this practice, few of the MBTA's bus routes receive adequate surveillance or regulation.

5.7.8 Lack of Supervision

Seventy-five percent of the MBTA's bus routes are supervised a.) by Inspectors at only one end, b.) at an intermediate point, or c.) not at all. Moreover, on routes with supervision at only one end, only outbound trips (half of the service) can be regulated. As

previously stated, late inbound trips tend to be discovered only if they are late enough to delay subsequent outbound trips. Only one-quarter of the T's bus routes are supervised at both endpoints. These are supervised simply because they happen to connect two supervised control points.

Supervision of bus service at intermediate points is made more difficult by the lack of intermediate point arrival time data. MBTA schedules are based, in part, on data provided by running time sheets which show expected travel times for individual MBTA routes and route deviations. Most, though not all, of the sheets include one or more intermediate time points, though the timetables themselves do not show intermediate time data. Despite the availability of data, headway sheets for intermediate points where many routes converge (i.e., Arlington Center, Roslindale Square, etc.) are not compiled. This is significant for reliability reasons in that random schedule adherence checks cannot easily be performed by Chief Inspectors who are assigned to mobile units. Though MBTA officials express their hope that the automated run-cutting system now being developed will remedy this handicap, most seemed oblivious to the fact that the MBTA currently has the capability to produce intermediate headway sheets for any point on the MBTA's bus system (cf. Appendix P).

5.7.9 In-Service Failures

Bus breakdowns increase headway variability. On several occasions, the study team witnessed in-service bus breakdowns. In each instance, the time needed for supervisory personnel or mechanics to reach the location of the vehicle exceeded the prevailing line headway

and, as observed, eventually caused one or more missed trips.

Many of the MBTA's buses are not radio-equipped, a factor which prevents drivers from directly requesting assistance from Central Control. Drivers must use the nearest public telephone to contact Central Control and then, if the problem warrants, wait for a mechanic to arrive. Chief Inspectors, who patrol their districts in radio-equipped vans, are sometimes prevented from quickly locating the scene of a breakdown by non-existent or broken bus radios. Many of the MBTA's hand-held portable radios are in poor condition. On more than one occasion, the study team witnessed Inspectors who had two portable radios - one for receiving and one for transmitting messages.

The speed at which in-service failures are remedied depends in great part on the proficiency of Inspectors and Chief Inspectors in troubleshooting procedures and the availability of tools and equipment. Of the field personnel interviewed by the study team, few felt that they were sufficiently trained in troubleshooting each type of vehicle operating in revenue service.

There is no known written manual available for field personnel which details procedures for in-service failures. Employees must rely on techniques learned in training programs. Thus, in theory, MBTA field supervisors are expected to know, from memory, how to troubleshoot each of the eight different types of buses the MBTA operates. As this is impractical, Inspectors and Chief Inspectors usually contact their base garage for instructions - consuming more time. In addition, there is a general feeling among maintenance workers that first-line transportation officials should not be tampering with ve-

hicles they know nothing about. Further exacerbating matters, several of the Chief Inspectors vans we checked lacked the proper tools and equipment as specified by the tool check list (cf. Appendix R).

Heavy traffic often prevents officials from reaching the scene of a breakdown. Chief Inspectors, who are commissioned as Street Railway Officers, rationalize that, like their police counterparts, they too should have sirens and blue beacons on their vehicles. Chief Inspector's vans are currently equipped with amber beacons and sirens. Several Chief Inspectors likened their vehicles to "undersized tow trucks" and stated that when being followed by a small vehicle with flashing amber beacons, most motorists do not yield the right-of-way. A number of them also stated that they had received speeding tickets while travelling to the scene of a breakdown or accident.

MBTA Chief Inspectors vans are not considered emergency vehicles by the Registry of Motor Vehicles and thus cannot display red or blue beacons (cf. Appendix M). Both MBTA Transportation and Police officials concur that there is a problem. However, they emphasize that situations requiring the presence of an Inspector or Chief Inspector may be time sensitive, but most are not life threatening.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Certain factors affecting bus service reliability such as the accuracy of running times, the adequacy of employee training programs and the availability to passengers of arrival time data can be directly addressed by MBTA management. Other, less predictable factors such as breakdowns and traffic congestion can be indirectly addressed by creating a more useful and flexible ability to respond.

From a passenger's perspective, a significant amount of MBTA bus service is unreliable. Conflicting, unenforceable standards and ineffective supervisory techniques probably contribute to this problem. Nevertheless, minor modifications to service standards and supervisory techniques could provide some relief.

Recommendations for improvement focus on training, deployment and supervision of personnel, adoption of new standards and adherence to existing standards for service reliability as well as minor changes in scheduling procedures.

Service reliability is directly related to the enthusiasm and skill of vehicle operators and first-line managers. The MBTA is a prime example of a system where, after a huge capital investment, the rolling stock is in fairly good shape but operating discipline and service reliability still need some work.

6.2 Management Structure

The MBTA is unique among large transit systems in that no single department or individual has the sole repsonsibility of monitoring service delivery. Other transit systems assign this function to a Control Section or Traffic Department. We recommend that the MBTA consider either forming a Traffic Section within the Transportation Department or creating the position of Manager of Service Reliability. The Manager of Service Reliability might head a field supervisory staff consisting of Central Control, Chief Inspectors and Inspectors, assuming total responsibility for monitoring and maintaining service reliability. Appendix N outlines the function of the Traffic Department at the Greater Cleveland Regional Transit Authority.

The addition of several Traffic or District Supervisors would form an intermediate level of management between the Manager and field supervisors. Their responsibility might be to assist Central Control staff as well as Chief Inspectors and Inspectors in the field. In addition, Supervisors could assume the duties of Manager of Service Reliability during evening and weekend periods when administrative personnel are off-duty. The collection of performance data as specified by the Service Policy might also be part of a Supervisor's responsibilities.

6.3 Service Standards

The Service Policy should be updated to reflect current management goals. New standards should be adopted which are strong enough to protect the public's substantial investment in mass transit yet suffi-

ciently flexible to allow for innovation. MBTA management should place the same emphasis on evaluating service output (delivery, reliability) as it does on input (vehicles, manpower, funding).

Reliability guidelines should include standards for intermediate and terminal arrival times in addition to those for terminal departure times. A standard which measures headway variability should likewise be added. Delineation of line responsibility for data collection and analysis is necessary to insure that the needs of management are met.

6.4 Schedule-Making

Service reliability is affected by the accuracy and effectiveness of schedules. Schedules need to be built using running time data which reflects real operating conditions. MBTA schedules should include more information on arrival times both at intermediate and terminal points and such information needs to be made available to both MBTA employees and passengers. <u>This task can be accomplished using existing resources</u>.

The MBTA should consider updating the running time sheets for each route to reflect the most recent changes such as traffic signals, traffic congestion and new construction. Running times should be broken down into hourly time periods with half-hour increments during weekday rush hours. Building running times in this manner would more accurately account for measurable patterns of "peaks" and "lows" in both passenger and vehicular traffic. In the future, the results of schedule adherence checks could pinpoint routes which need follow-up running time checks.

Excessive nonproductive layover time should be eliminated from timetables wherever possible. By basing schedules on actual operating conditions, the MBTA could lessen its dependence on layover time as a means of maintaining regular headways.

6.5 Driver Training and Equipment

The training and recertification programs for Inspectors and Chief Inspectors do not place enough emphasis on service delivery. The job of regulating headways could be eased if each employee, from drivers to supervisors, were instructed in the importance of service reliability and understood how he/she plays a distinct and important role in maintaining reliable service. Further, they should be shown how their efforts affect the public's image of the MBTA.

To most MBTA bus passengers, drivers are the MBTA. The majority of drivers perform their duties in a conscientious and professional manner and pride themselves on being reliable. But inadequate training, poor flow of information and spotty supervision conspire to pinpoint the driver in the public's eye as the "bad guy" when it comes to poor service delivery.

Drivers are not given adequate training in techniques of schedule adherence or adequate information regarding expected arrival times. Drivers need more detailed intermediate and terminal arrival time information. Such information is found on a driver paddle. Most other transit systems use paddles or similar methods of disseminating precise schedule information to drivers.

The MBTA currently has the capability to build driver paddles.

We recommend that the MBTA provide all drivers with paddles showing the following information:

a.) the run number;

b.) report time;

c.) pullout time;

d.) special instructions on detour routes and proper destination signs;

e.) route number for each trip;

f.) several intermediate time checks along each route;

g.) pullback and off time; and,

h.) platform hours.

Spaces should also be provided for drivers to record vehicle number, revenue collected, actual pullout and pullback times, and unusual incidents (i.e. accidents, missed trips, etc.). Future driver training programs should stress the importance of following the schedules and instructions on the paddle as closely as possible. Sample paddles are shown in Appendix O.

6.6 Inspector/Chief Inspector Training

Management should clearly define the intended role of Inspectors and Chief Inspectors. If their primary function is determined to be one of security and public safety, as is currently perceived, then jurisdictional disputes with the MBTA Police need to be settled. If, on the other hand, their role is determined to focus primarily on service regulation, Inspectors and Chief Inspectors need to be given the proper tools to perform their intended function. Such tools include schedule information, portable radios, tool-equipped vans and

support and cooperation from management.

Involving first-line supervisors in operations planning would seem to have a dual benefit. Field supervisors are the "eyes" of management and as such are a valuable resource for management in operations planning. In addition, by being given the opportunity to provide input into planning, Inspectors and Chief Inspectors would see management as more aware of their plight and more receptive to their needs. The addition of a one-time "round-table" meeting to the recertification program is only a first step. Several of the transit systems we surveyed use a technique where self-monitoring reports are filed regularly by first-line supervisors. The reports include:

a.) the supervisor's best achievement during the period;

b.) the supervisor's most serious problem during the period; and,

c.) the supervisor's most important idea for improving either operations or supervision.

The reports are usually accompanied by periodic "quality circle" meetings involving first-line supervisors and middle management. It is our recommendation that a similar program of feedback and regular discussion group meetings be implemented at the MBTA.

Because MBTA timetables change quarterly, self-evaluation reports could be completed quarterly and quality circle meetings be held just prior to timetable changes. In this manner, Inspectors and Chief Inspectors would be afforded the opportunity to provide input into subsequent timetable changes before runs are cut while first-line supervisors are simultaneously being briefed on final management plans

for the upcoming timetable change.

6.7 Supervisory Techniques

Foremost among our recommendations for improving supervision is that Inspectors and Chief Inspectors be provided with the departure and arrival times pertinent to their respective stations or districts. Examples of point headway sheets are shown in Appendix P. Production of intermediate or terminal headway sheets need not wait until the TCIS is in place (1987) as the MBTA currently has the capability to produce headway sheets for all terminal and intermediate points. The MBTA's Plans and Schedules Department currently produces headway sheets for Inspectors which show originating and passing trips at the Heath Street Loop. A copy is included in Appendix P.

To enhance the positive impact of supervisory presence, Chief Inspectors should make random on-time checks at various points thoughout their districts. Moreover, to enhance the effectiveness of the schedule adherence monitoring effort, drivers must be informed that their on-time performance both at terminals and intermediate points is being monitored by supervisory personnel on a regular but random basis. Schedule adherence forms for each location should be completed and sent to the Traffic Supervisor responsible for that district. In addition, schedule adherence levels should be a regular topic for discussion at quarterly management meetings.

In addition to schedule adeherence checks, we recommend that the MBTA initiate regular on-board operator performance checks. This function may be performed by traffic checkers or Inspectors.

It is recommended that each full and part-time driver be observed while operating in passenger service at least once each year unless complaints or accidents warrant additional checks. Plain-clothes inspectors are employed by several transit systems including the New York City Transit Authority and the Pioneer Valley Transit Authority in Springfield. However, it is not recommended that plain-clothes checks be performed on the MBTA unless a driver has a particularly poor record. Undercover checks can foster an atmosphere of mistrust and lack of respect. In-service performance evaluations should be made available for inspection by the driver in question and then made a part of that driver's personnel file. Examples of driver surveillance sheets are shown in Appendix Q.

6.8 Tools and Equipment

The lack of tools and equipment was frequently cited by supervisors as an obstacle to better job performance. Our observations confirmed Inspector's and Chief Inspector's concerns about broken portable radios which either do not properly transmit or receive messages. It appears that MBTA management concurs. In December 1985, the MBTA Board of Directors approved the purchase of 54 hand-held portable radios for the Operations Directorate. When the radios are delivered in late 1986, 40 older radios will be retired. We recommend replacement of radios as they reach the end of their useful service lives (8-12 years).

Supervisors are required to complete an equipment check list at the end of his/her shift. However, although we observed vans with equipment missing, we were unable to confirm whether this task is

widely performed or whether management is responsive to the problem. We recommend that MBTA management assure that appropriate equipment check lists are completed before and after each tour of duty and that missing or broken equipment be repaired or replaced as soon as possible. The possibility of pilferage should be examined.

Supervisors raised concerns about not being sufficiently trained in troubleshooting each type of vehicle operating in revenue service. The MBTA currently has eight different types of buses in operation. The nature of problems and the remedial action necessary varies tremendously from one vehicle type to the next. This is especially true on the newer GMC RTS-II-04 buses. Field supervisors can not be expected to always know the mechanical proclivities of eight vehicle types. However, should the Inspector arrive at the scene of a breakdown before a mechanic, his/her ability at troubleshooting could mean the difference between one missed trip and five and could save the MBTA the expense of a replacement vehicle and driver. On the other hand, the Inspector should be able to quickly determine whether the problem is serious enough to require a mechanic or towing.

The Chicago Transit Authority, which operates a wider variety of vehicles than the MBTA, provides its field supervisors with a pocket-sized troubleshooting guide (cf. Appendix R). The guide clearly outlines in a step-by-step manner the action to be taken by the field supervisor. In addition, the guide tells the supervisor when the bus should be taken out of service and when a mechanic should be summoned.

We recommend that the MBTA consider producing a similar manual for its Inspectors and Chief Inspectors. The troubleshooting manual

would point out not only what action the Inspector should take, but would also solve jurisdictional problems between Automotive Equipment and Transportation (i.e. when the Inspector is "over his head" and requires a mechanic).

6.9 Deployment of Field Personnel

A significant conclusion made from this study was that the presence of supervisory personnel had a positive affect on service reliability. Furthermore, our observations documented that headway variability tended to diminish in the direction of travel toward a control point. Thus, despite the inconsequential nature of supervisory techniques currently used by Inspectors, it appears that the MBTA's existing use of direct supervision as a means of improving reliability is at least marginally successful.

Based on our observations, it appears that stationing Inspectors at control points on a random, rotating basis might well be as effective as the present stationary supervisors and would provide wider coverage at a lower cost. We recommend that the MBTA look into the possibility of expanding the coverage provided by Inspectors by requiring that they spot-check service performance at several points in the vicinity of their base stations. For example, the Inspector based at Arlington Heights might periodically monitor on-time performance at various points along Massaschusetts Avenue in Arlington and Lexington. Likewise, the Inspector assigned to North Point in South Boston could make spot-checks along routes throughout South Boston.

UMTA's Minneapolis study found that supervision itself positively impacted service reliability beyond the period in which it was admin-

istered. Thus, even with a change from stationary to partially mobile Inspectors, the high level of reliability at control points should be sustained.

6.10 Future Research

Study results indicate that, despite the collective efforts of hundreds of MBTA bus drivers and their supervisors, passengers widely perceive T bus service as unreliable with highly variable headways. Our observations identified several areas in need of remedial action, including management structure, employee training and supervision and service standards.

Areas recommended for further research include the following:

- The specific external sources of reliability problems (i.e., maintenance, traffic congestion, scheduling, etc.) and possible methods of recognizing and overcoming each.
- The advantages and disadvantages of either creating the position of Manager of MBTA Service Reliability or adding a Traffic Section to the MBTA's Transportation Department.
- The potential application of AVM technology to the MBTA bus system.
- The overall effectiveness of the MBTA's current driver and supervisor training programs, to include an examination of how training programs can be enhanced.
- The effects of various supervisory and/or disciplinary techniques on employee morale, motivation and service reliability.
- Alternative field supervisory deployment scenarios and the effect of each on service reliability and manpower costs.
- The effect of decentralizing the radio function of Central Control among the bus rating stations.
- The possibility of establishing a system of rewards or benefits to drivers who maintain a high level of schedule adherence.

APPENDIX A

PROPOSED CHANGES TO THE SERVICE POLICY

Prepared by MBTA Service Planning staff, March 1985.

A. Why Revise the Service Policy?

In its current form, the Service Policy includes long lists of goals, objectives, standards and guidelines, only some of which have been useful in planning and scheduling service. The purpose of revising the Service Policy is to emphasize the most important objectives and standards, and to eliminate those that have not been practical. We hope that these changes will make the Service Policy a stronger tool for ensuring that the public investment in MBTA service is spent as productively as possible.

B. General Problems with the Current Service Policy and Proposed Solutions

In revising the Service Policy, we should overcome the following problems with the existing policy:

1. **LACK OF DATA** - The MBTA Scheduling and Service Planning Departments have lacked the data necessary to determine whether or not current bus routes meet the service standards, or whether service could be modified to conform more closely to the objectives stated in the Policy.

   Proposed Solution: Include in the Service Policy specific procedures for collecting and maintaining sufficient ridership and service data to support the level of analysis prescribed by the Policy.

2. **CONFLICTING OBJECTIVES** - While most of the objectives, standards and guidelines in the current Service Policy are independently useful, it is often impossible to comply with one without violating others. (Examples of such conflicts are given later in this report.) Conflicting objectives do not help the Scheduling and Service Planning Departments with the difficult trade-offs that arise is planning service.

   Proposed Solution: Limit the stated objectives, standards and guidelines to those we can stick to in almost every planning decision.

3. **EXCESSIVE SCOPE** - Some of the standards and objectives refer to service characteristics beyond the control of the MBTA. For example, one objective is to "maximize average operating speeds," which are largely a function of traffic conditions. It is unrealistic to expect MBTA personnel to alter operating speeds significantly through discussions with local traffic officials, as the current Policy suggests. Overambitious standards such as this detract from the Service Policy's credibility and, consequently, its power.

   Proposed Solution: Eliminate all standards concerning aspects of service beyond the control of the Service Planning, Scheduling, or Transportation Departments.

4. **LACK OF GUIDANCE FOR IDENTIFYING AND DEALING WITH SUBSTANDARD ROUTES.** While the current Policy has many objectives, standards, and guidelines, it has only vague suggestions for determining whether or not routes meet the standards and for dealing with routes that violate the objectives and standards.

> Proposed Solution: Include in the Policy standard procedures to ensure that service conforms to the stated objectives. For example, include standard procedures for routinely adjusting headways to minimize waiting time without violating the loading standards or policy headways. Also include procedures for estimating the marginal costs and revenues of individual services, in order to determine which routes meet the economic productivity standards.

C. <u>Overview of the Draft Revised Service Policy.</u>

I. Purpose of the Service Policy

II. Service Objective

III. Service Standards and Guidelines

IV. Procedures for Monitoring and Evaluating Existing Services

a. Monitoring Procedures (appendix??)

b. Routine Evaluation Procedures (appendix??)
-check loads factors - identify routes violating the loading standards
-check total ridership, revenue, and cost - identify routes below productivity standards.
-check reliability - identify substandard routes

V. Procedures for Routine Service Adjustments (appendix??):

a. Procedures for Determining the Level of Service on Individual Routes.

b. Procedures for Determining the allowed times for individual routes.

VI. Procedures for Evaluating Proposals for New Services
-application and review procedures (Service Committee)
-ridership forecasting (appendix)
-cost estimation (appendix)
-comparison with currently least productive routes.

VII. Roles and Responsibilities - MBTA departments, Advisory Board

VIII. Operating Responsibilities (private carriers)(????)

APPENDICES

A. Procedures for Estimating the marginal costs of individual routes.

B. Procedures for Estimating and Forecasting Ridership

C. Procedures for determining the reliability of service and for improving reliability on substandard routes.

D. Procedures for determining locations for passenger shelters

D.

DRAFT REVISED SERVICE POLICY

PARTS I, II, AND III

I. PURPOSE OF THE SERVICE POLICY

To help the MBTA to determine which services to provide.

II. SERVICE OBJECTIVE

To maximize ridership while:

-holding the operating deficit to the authorized level;

-providing access to jobs, shops, and recreational activities in all areas within the MBTA district where there is reasonable demand for public transportation.

III. PLANNING GUIDELINES AND STANDARDS

The following guidelines and standards are intended to help the Authority meet the objective of maximizing ridership subject to the subsidy and accessibility constraints. Generally stated, the guidelines are to make service as attractive as possible and to eliminate extremely unproductive services.

III.1 Accessibility Guideline

Provide service to within at most one half mile of almost all residences in areas with a population density in excess of 5,000 (???) people per square mile.

Data Required: Map with existing route structure, population densities by Census tract or traffic zone.

III.2 Convenience Guidelines

III.2.a **Provide at least one trip each hour during the periods that service is provided on all routes**

III.2.b **Minimize the time passengers wait for transit service.** (See Section V.1--Procedures for determining the level of service on each route.)

Data Required: Ride checks (i.e. observations of the numbers of people getting on and off each trip at each stop) and point checks (i.e. estimates of the number of passengers on board each bus as it passes the peak load point).

III.2.c **Avoid transfers** - except when the difference between the net costs of providing through service and connecting services could be invested elsewhere to attract more new passengers.

Data Required: Passenger Surveys. (i.e. passengers must periodically be asked to fill out questionnaires about their origins and destinations.)

III.3 Comfort and Safety Guidelines

III.3.a **Avoid overcrowded buses.**

Maximum Loads Standards
-Peak half hour - all the trips on any route should have average load factors of no more than 140%.

Data Required: Peak load counts. Occasionally, peak load counts must be supplemented with ride checks to determine the location of the peak-load point.

III.3.b **Provide passenger shelters at busy stops.** (See Appendix D: Procedures for Determining Locations for Passenger Shelters.)

Data Required: Ride checks.

III.4 Reliability Guideline

At least 80% of all trips should leave on time. (A trip is defined as leaving "on time" if it leaves within 5 minutes of the scheduled departure time. (See Section V.2--Procedures for Determining the Allowed times for Individual Routes.)

Data Required - Actual trip departure times compared with scheduled departure times.

IV.5 Productivity Guideline

Eliminate Unproductive Services

Productivity Measure - Passengers per revenue hour. All routes should be compared on the basis of this measure and the poorest routes should be eliminated whenever the resources used for these routes could be used elsewhere to generate more ridership.

E. Discussion of the Objectives in the Existing Service Policy

A number of the objectives in the existing Service Policy will not be essential if the proposed Policy is adopted. The following discussion shows that each of these objectives is either covered by the proposed goals and standards, or conflicts with them. Consequently, we will not lose anything by switching to the proposed Policy.

(Note: Each of the existing objectives is included in boldface, followed by a discussion.)

3.2.1 Accessibility

a.) Provide regular-route public transportation service to satisfy the major travel desire lines of the great majority of residents in the MBTA area.

b.) Provide supplementary community-based services to satisfy the needs of the elderly, handicapped and other special market groups.

c.) Provide a network of regular-route and special services to facilitate access to major centers of employment, commercial, recreational, educational, medical and governmental activity.

Part a is covered by the proposed accessibility constraint. Part b should be eliminated for three reasons. First, we do not do this. Second, we cannot endorse special services regardless of cost, which is what this objective implies. Finally, if the policy must include special provisions for the elderly and the handicapped, these provisions should be in the form of relaxed service standards for areas with high percentages of elderly and handicapped.

3.3.2 Convenience and Speed

a.) provide service that is reasonably direct and effective in transporting passengers

b.) Provide service that minimizes:

i) trip travel time by transit.

ii) aggregate "excess time" related to walking to and from transit services, waiting for transit vehicles and transferring

Part bi is included in the proposed service guidelines, but parts a and bii often conflict with part bi. For example, one

way to minimize "excess time related to walking to and from transit services" is to provide many straight routes close together. Under this plan, service is "reasonably direct" but not usually very effective. Unless the market density is extremely high, each route carries only a few passengers. An alternative plan would be to provide a few circuitous routes, each of which could be effective in gathering passengers and minimizing "excess time," but none of which would be direct.

The tradeoffs related to these objectives arise in many routing decisions and are extremely complex. These decisions should be handled case by case to comply with the objective of maximizing ridership. Additional objectives only complicate the decision, rather than guiding it.

c.) Provide service that is competitive with automobile travel in terms of overall travel times and cost

This objective is unrealistic. Once a route is designed, the travel time is a function of the service frequency and the traffic conditions. Consequently, while some routes are direct and frequent enough to compete with the automobile in terms of travel time, others are too infrequent and circuitous to compete. Since such slow routes are often aligned and scheduled as effectively as possible, any changes would decrease ridership and/or increase costs.

d.) Provide schedules that are easily remembered by customers when headways exceed 10 minutes.

I do not think we should have an "objective" about clock headways, although it would be useful to analyze their costs and benefits in detail. There are two major problems with such a general objective. First, since clock headways tend to lengthen layovers, the inconvenience of the extra wait may outweigh the convenience of easy-to-remember departure times. Second, since long layovers cost more than short layovers, clock headways can be expensive, and it may be possible to attract more ridership with the same money through other service improvements. Perhaps the Service Policy should include clear procedures for determining when we should have clock headways, but it should not include an unqualified objective promoting them.

3.2.3 Safety and Comfort

a.) Offer public transportation that is safer than any other mode of transportation

b.) Provide clean and comfortable equipment and facilities.

c.) Provide shelters for passengers at major boarding points where service in infrequent.

Part c is included in the proposed guidelines. The other parts, however, should not be part of the Service Policy. While the policy can help us tremendously with the trade-offs between competing services, it is much more difficult to develop general guidelines for the tradeoffs between service and maintenance. The Policy will be most powerful if it its scope is limited and the focus should be on service planning and scheduling.

3.2.4 Efficiency

a.) Provide rush hour and off-peak services that optimize utilization of manpower, vehicles and other resources while encouraging maximum use of the entire network of public transportation services.

b.) Minimize under utilized and/or inefficient services which are a drain on transportation resources without sufficient offsetting benefit.

Part a is included in the objectives of maximizing ridership subject to the subsidy constraint. Part b is redundant with the proposed economic and productivity standards.

c.) Maximize average operating speeds

This objective does not belong in the service policy. The operating speed of a route is a function of the neighborhoods it travels through, the type of roads it uses, the traffic it encounters, and other factors that have nothing to do with service planning or scheduling. If the MBTA took the goal of maximizing average operating speeds seriously, we would eliminate local services in favor of express service. This step would conflict with the goal of maximizing ridership and with the commitment to provide access.

d.) Minimize the ratio of recovery time to revenue - producing time

This objective was intended to make sure that costs are not unnecessarily high, but it is not very useful. Some recovery time is essential if we are to provide reliable service; and the "minimum" amount of recovery time is implied by the service standard that a fixed percentage of trips should be on time. In addition, non-revenue time is sometimes built into the schedule in order to provide clock headways, or simply cannot be avoided because of the inherent difficulty of building a schedule.

As long as our objective is to maximize ridership given a fixed subsidy, we will inevitably avoid excess recovery time whenever possible since recovery time costs money but does not attract ridership. There is no need to state this objective separately

e.) Minimize operation of redundant or competitive services

What is a redundant or competitive service? Unless we have a clear definition, it will be difficult to follow this objective. Furthermore a clear definition could lock us into routing decisions that conflict with the basic objective of maximizing ridership subject to the budget constraint.

For example, one might define redundant services as "parallel routes within one half mile of each other," but this would mean that route 57 is "redundant" with the Green Line. Actually, however, route 57 is much more convenient than the Green Line for many people, and it helps to control overcrowding on the Green Line.

Similarly, according to the same definition of redundant services, route 77 between Alewife Brook Parkway and Harvard Square would certainly be "redundant" with the new extension of the Red Line. But if we were to avoid this redundancy by terminating route 77 at Alewife, we might lose more riders than we could possibly attract by investing the savings elsewhere. In that case, we would violate the overall objective of maximizing ridership subject to the budget constraint.

As long as we follow the overall objective of maximizing ridership subject to the budget constraint, we will inevitably eliminate the truly wasteful services, but we will retain pairs of similar services with important distinctions.

f.) Maximize the utilization of private transportation services, where cost effective to the public in the provision of transportation for specialized market segments or service configurations. Examples of such specialized transportation are: school service; community-based para-transit; para-transit for the elderly and handicapped.

This objective does not need to be stated in the Service Policy since, in maximizing ridership subject to a budget constraint, we will often find that contracting for privately-operated service is more efficient than operating service ourselves.

F. TASKS INVOLVED IN COMPLETING THE DRAFT REVISED SERVICE POLICY

I. REVIEW AND APPROVAL PROCESS

1. Discuss draft with Service Committee.

2. Discuss draft with Lewjean Holmes.

3. Meet with Advisory Board members in groups of 4 to 6 to discuss the draft and solicit comment.

4. Revise draft based on comments from above.

5. Present revised draft to the board

6. Revise draft based on Board Comment, if necessary.

7. Obtain Board approval

II. FURTHER POLICY DEVELOPMENT

1. Develop appendices and procedures for later approval by Board.

2. Determine a reasonable accessibility guideline.

3. Determine a reasonable level for the reliablity guideline

4. Develop procedures for determining level of service on individual routes.

5. Develop ridership and reliability monitoring procedures.

6. Develop ridership forecasting procedures

7. Write remaining sections and appendices

8. Present remaining procedures for Board Approval

APPENDIX B

BUS/TRACKLESS TROLLEY PORTION OF OPS-250

		SCHEDULED	EXTRAS	TRAINING	AVAILABLE	OVER/ SHORT
ALBANY	072	[illegible]	—	—	100	8
BARTLETT	080	147	—	03	161	11
SOM/CTN	105	167	—	—	175	8
QUINCY	090	74	—	02	76	—
LYNN	120	77	—	—	84	7
CABOT	071	132	—	02	141	7
FELLS	112	78	—	—	87	9
TOTAL		767	—	07	834	50
NOR CAMB	130	24	—	01	33	8

BUS AND TRACKLESS TROLLEY TRIPS NOT RUN					ROAD CALLS
VEHICLE N/A	OPERATOR N/A	DISABLED VEHICLE	MISCELLANEOUS	TOTAL	
—	—	01	—	01	01
—	03	04	08	15	02
—	06	045	05	155	11
—	—	005	—	005	02
—	045	01	—	055	02
—	01	14	—	15	11
—	—	01	—	01	03
—	145	26	13	535	32
—	—	—	—	—	—

QUINCY 2-TRAINING

		DISABLED EQUIPMENT (DAILY TOTAL)		
		UNLOADED	BUS SWAP	TOTAL
ALBANY	072	01	—	01
BARTLETT	080	01	—	01
SOM/CTN	105	—	—	—
QUINCY	090	03	—	03
LYNN	120	—	02	02
CABOT	071	05	13	18
FELLS	112	—		—
TOTAL		10	15	25
NOR CAMB	130	—	—	—

DAILY ROUND TRIP SUMMARY			
SCHEDULED	ADDED	NOT RUN	OPERATED
5680	12	01	579
15735	14	16	15725
15640	48	155	15965
6415	—	005	641
6095	—	055	604
15860	17	[illegible]	1598
5980	—	01	597
71405	91	535	7178
2950	—	—	295

Do not keypunch decimal points or data in shaded areas. Keypunch dashes (-) as zeros (0).

CABOT ShuTTlE- 57

ChARLESTOWN ShoTTlE- 78

MTH DTE YR

DATE: 04/ 02 /86

DAILY REVENUE VEHICLE SERVICE REPORT: BUSES AND TRACKLESS TROLLEYS

APPENDIX C

SCHEDULED WEEKDAY ROUND-TRIPS ON TEST ROUTES

Route	Termini	Daily Trips
30.0	Mattapan-Roslindale Square	44
34.0	Arborway-Dedham/East Walpole	131
35.0	Arborway-Dedham Mall via Stimson	40
36.0	Arborway-Charles River Loop	67
37.0	Arborway-Vermont Street	40
40.0	Arborway-Georgetowne	29
50.0	Arborway-Cleary Sq. via Roslindale	30
51.0	Arborway-Cleveland Circle	33
53.0	Newton Corner-Roberts	15
54.0	Newton Corner-Waverly	14
56.0	Newton Corner-Waltham Highlands	14
58.0	Newton Corner-Auburndale	14
60.0	Kenmore-Chestnut Hill	54
61.0	Waltham-Lexington Center	11
65.0	Kenmore-Brighton Center	29
66.0	Dudley Station-Allston	95
70.0	Cambridge-Waltham (Cedarwood)	57
73.9	Harvard-North Cambridge	61
76.0	Harvard-Hanscom AFB	18
77.0	Harvard-Arlington Heights	164
83.0	Central-Ringe Avenue	54
84.0	Harvard-Arlmont Village	24
87.0	Lechmere-Arlington Center	54
88.0	Lechmere-Clarendon Hill	63
90.0	Davis-Wellington	21
94.0	Harvard-Medford via West Medford	48
95.0	West Medford-Sullivan	50
96.0	Harvard-Medford via George Street	46
97.0	Wellington-Malden Station	18
99.0	Wellington-Upper Highland	42
101.0	Malden-Sullivan via Winter Hill	59
104.0	Malden-Sullivan via Ferry Street	50
105.0	Malden-Sullivan via Faulkner	16
106.0	Wellington-Linden	45
108.0	Wellington-Lebanon	43
130.0	Lebanon-Wyoming via Malden	18
131.0	Melrose East Side	17
134.0	Wellington-North Woburn	39
135.0	Malden-Reading	32
305.0	Waltham-Downtown Turnpike Express	33
315.0	Roslindale-Back Bay Express	4
326.0	West Medford-Downtown I-93 Express	10
350.0	Burlington-Downtown Limited	26
411.0	Malden-Revere Beach	11
430.0	Malden-Saugus Center	17
	TOTAL ALL TEST ROUTES	1,807
	ALL MBTA BUS ROUTES (SPRING 1985)	6,664
		27.11%

APPENDIX D

MBTA BUS SERVICE PERFORMANCE BY AREA

GARAGE		% SCHEDULED TRIPS MISSED 1983	1984	1985
Albany Street (South End)	Turnpike express routes to Newton, Watertown, Needham and some Boston local routes.	1.4%	1.1%	1.2%
Bartlett (Roxbury)	Roxbury, Hyde Park, Roslindale, Jamaica Plain, West Roxbury, Mattapan, Brookline and Allston	1.6%	1.3%	2.0%
Charlestown	Charlestown, Somerville, Cambridge, Medford, Arlington and suburban points north and northwest of Boston.	.9%	.7%	.8%
Quincy	Quincy, Randolph, Weymouth and suburban points south of Boston and along the South Shore.	.7%	.8%	.5%
Lynn	East Boston, Revere, Lynn, Saugus, Salem, Swampscott, Marblehead and points along the North Shore.	.6%	.6%	.5%
Cabot (South Boston)	Central Boston, South Boston, Dorchester, Upper Roxbury, Watertown, Brighton and between Dudley Station (Roxbury) and Harvard.	1.9%	1.7%	2.1%
Fellsway (Medford)	Medford, Malden, Everett, Revere, Chelsea, Saugus and points north to Wakefield and Reading.	.6%	.5%	.6%
North Cambridge	Trackless Trolley routes in Cambridge, Belmont and Watertown.	.7%	1.1%	.6%

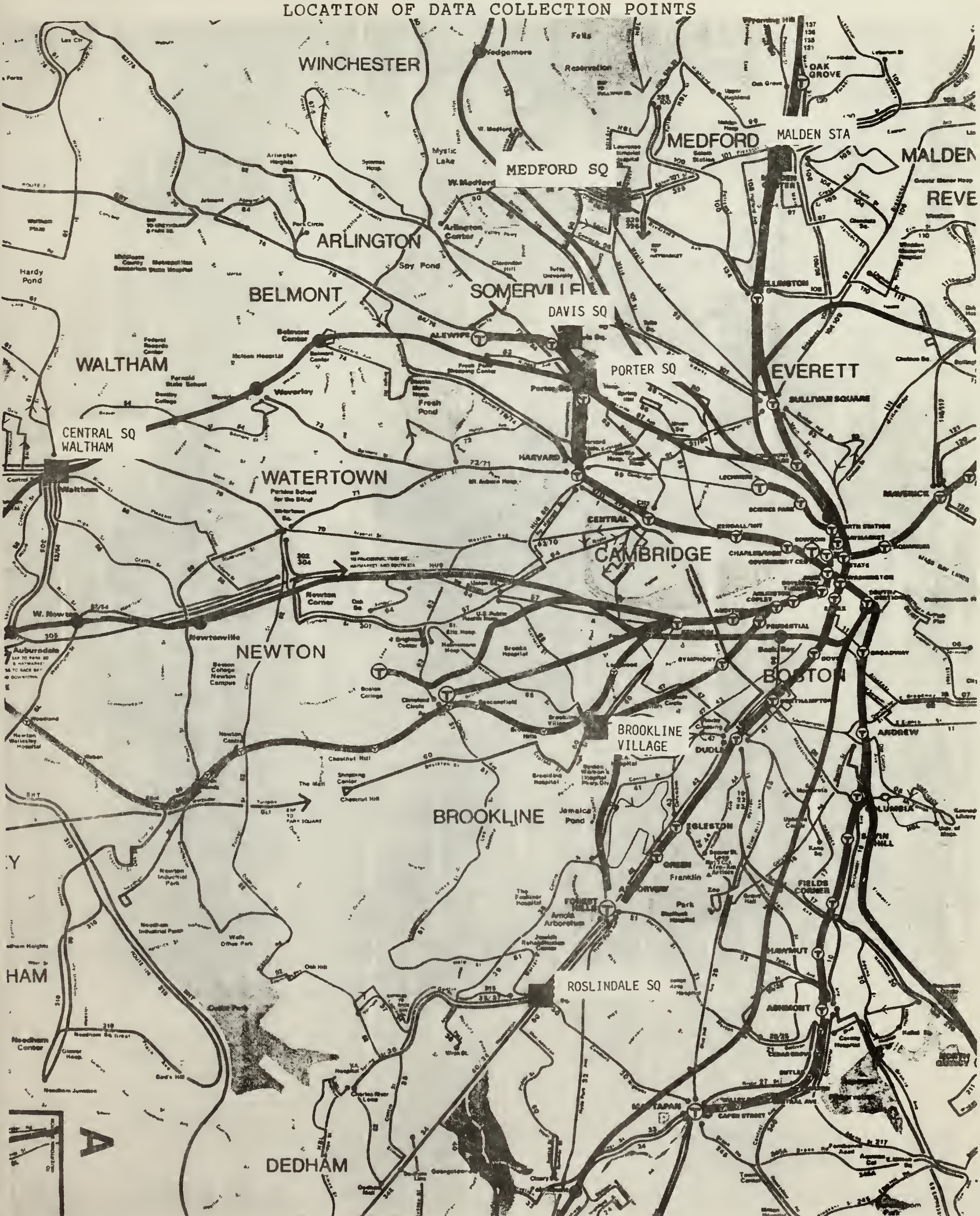
APPENDIX E

MBTA 1985 BUS SERVICE PERFORMANCE

		TRIPS MISSED DUE TO:					
	SCHEDULED	VEHICLE		CREW		MISCELLANEOUS	
DEPOT	BUS TRIPS	##	%%	##	%%	##	%%
Albany Street	136,273.0	831.5	52.5%	634.0	40.0%	118.0	7.5%
Bartlett	273,453.5	1,842.5	33.0%	1,752.5	31.4%	1,988.0	35.6%
Charlestown	396,307.5	1,461.5	43.5%	1,234.0	36.7%	666.5	19.8%
Quincy	154,557.5	456.5	54.2%	351.5	41.8%	33.5	4.0%
Lynn	158,400.5	560.5	75.6%	153.0	20.6%	27.5	3.7%
Cabot	367,790.0	3,776.0	48.2%	3,833.0	48.9%	231.0	2.9%
Fellsway	131,928.5	406.0	50.2%	298.5	36.9%	103.5	12.8%
Trackless Trolley	70,150.0	134.5	30.7%	239.0	54.6%	64.0	14.6%
MBTA BUS SYSTEM	1,688,860.5	9,469.0	44.7%	8,495.5	40.1%	3,232.0	15.2%

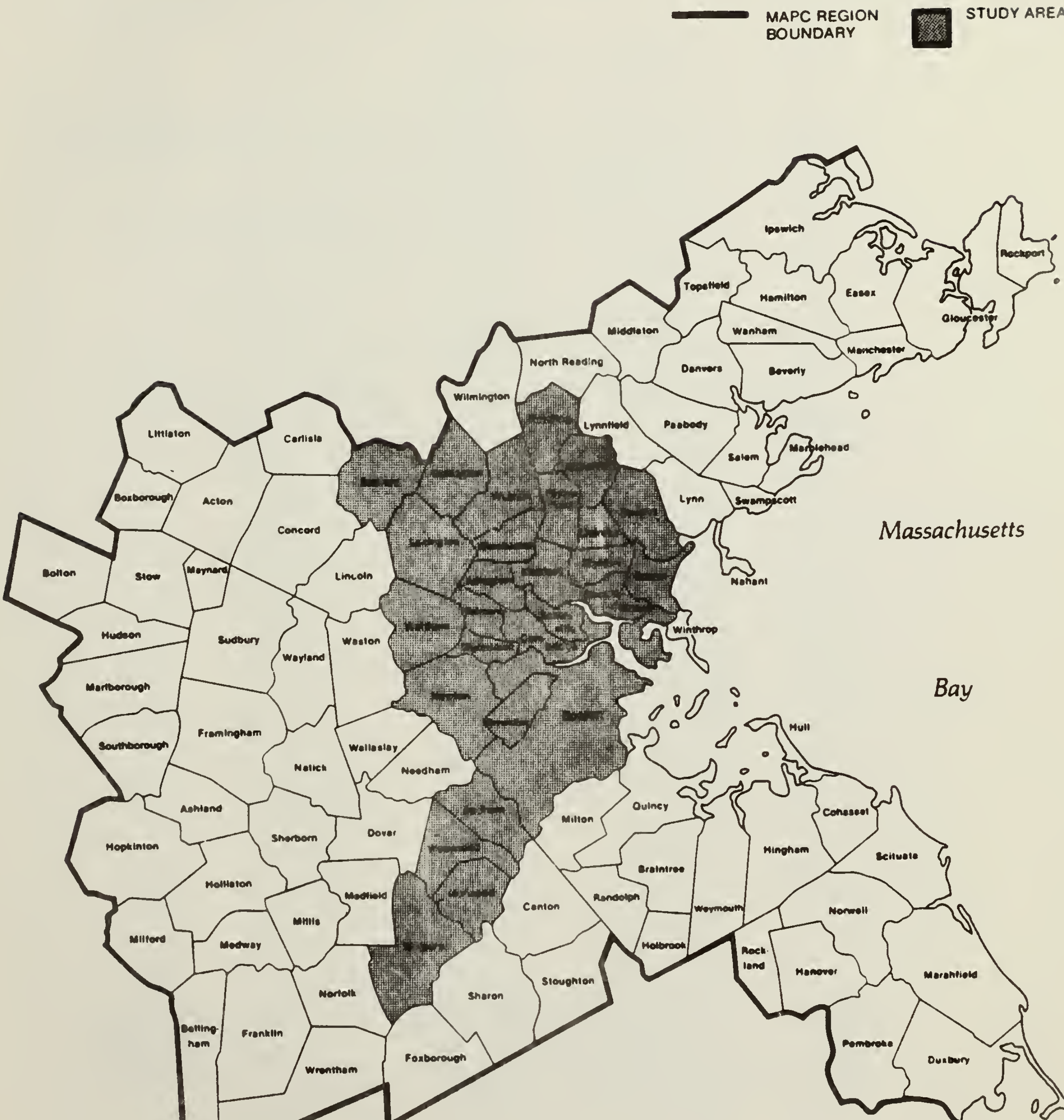
APPENDIX F

LOCATION OF DATA COLLECTION POINTS



APPENDIX G

CITIES AND TOWNS SERVED BY BUS ROUTES TESTED



APPENDIX H

SAMPLE CALCULATION SHEET

MBTA Advisory Board
Study of MBTA Service Reliability

DATE: Tuesday, April 23, 1985
ROUTE: 101 Malden-Sullivan via Winter Hill
BEGINNING TIME: 7:50am
LOCATION: Medford Square

WEATHER: Cloudy, Cool
ANALYST: Connie

DIRECTION: Malden Sta SCHEDULED HEADWAY: 22 Minutes		DIRECTION: Sullivan Sta SCHEDULED HEADWAY: 13 Minutes	
Passing Time	Observed Headway	Passing Time	Observed Headway
7 59		7 54	
8 4	5	7 59	5
8 15	11	8 2	3
8 36	21	8 5	3
8 56	20	8 9	4
9 16	20	8 10	1
9 34	18	8 19	9
9 50	16	8 24	5
	0	8 33	9
	0	8 39	6
	0	8 53	14
	0	9 15	22
	0	9 30	15
	0	9 47	17
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0
	0		0

Mean Observed Headway	15.86	Mean Observed Headway	8.69
Headway Variance	-27.9%	Headway Variance	-33.1%
Standard Deviation +(-)	5.44	Standard Deviation +(-)	6.17
Coefficient of Variation	34.3%	Coefficient of Variation	71.0%
Mean Expected Waiting Time	8.86	Mean Expected Waiting Time	6.54

SUMMARY RESULTS LISTED BY ROUTE

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850425	M	30.0	MATTAPAN	ROSLINDALE	20	20.40	1.02	5.00
850501	A	30.0	MATTAPAN	ROSLINDALE	19	18.88	7.80	41.31
850430	P	30.0	MATTAPAN	ROSLINDALE	20	20.17	0.90	4.46
850425	M	34.0	ARBORWAY	ROSLINDALE	30	27.00	6.98	25.85
850425	M	34.0	DEDHAM LINE	ROSLINDALE	20	24.00	7.71	32.12
850501	A	34.0	DEDHAM LINE	ROSLINDALE	7	8.00	2.83	35.37
850501	A	34.0	ARBORWAY	ROSLINDALE	7	7.82	3.26	41.68
850430	P	34.0	DEDHAM LINE	ROSLINDALE	6	6.78	3.88	57.22
850430	P	34.0	ARBORWAY	ROSLINDALE	6	9.25	4.88	52.75
850501	A	34.5	EAST WALPOLE	ROSLINDALE	20	17.13	6.45	37.65
850501	A	34.5	ARBORWAY	ROSLINDALE	15	16.43	3.58	21.78
850430	P	34.5	EAST WALPOLE	ROSLINDALE	18	28.50	5.02	17.61
850430	P	34.5	ARBORWAY	ROSLINDALE	21	42.50	18.50	43.52
850425	M	34.6	EAST WALPOLE	ROSLINDALE	30	27.67	4.19	15.14
850425	M	34.6	ARBORWAY	ROSLINDALE	30	32.00	5.66	17.68
850425	M	35.0	ARBORWAY	ROSLINDALE	30	25.00	2.45	9.80
850425	M	35.0	DEDHAM MALL	ROSLINDALE	30	31.00	5.10	16.45
850501	A	35.0	DEDHAM MALL	ROSLINDALE	20	22.67	3.35	14.77
850501	A	35.0	ARBORWAY	ROSLINDALE	20	20.00	1.91	9.55
850430	P	35.0	DEDHAM MALL	ROSLINDALE	13	12.29	3.95	32.13
850430	P	35.0	ARBORWAY	ROSLINDALE	13	16.60	3.93	23.67
850425	M	36.0	CHARLES RIVER	ROSLINDALE	30	32.67	3.40	10.40
850425	M	36.0	ARBORWAY	ROSLINDALE	30	39.67	10.66	26.87
850501	A	36.0	CHARLES RIVER	ROSLINDALE	10	9.64	3.75	38.90
850501	A	36.0	ARBORWAY	ROSLINDALE	10	10.83	2.91	26.86
850430	P	36.0	CHARLES RIVER	ROSLINDALE	13	13.89	2.92	21.02
850430	P	36.0	ARBORWAY	ROSLINDALE	13	13.38	5.00	37.36
850425	M	37.0	VERMONT	ROSLINDALE	30	32.33	5.44	16.82
850425	M	37.0	ARBORWAY	ROSLINDALE	30	29.33	6.18	21.07
850501	A	37.0	VERMONT	ROSLINDALE	20	22.17	2.34	10.55
850501	A	37.0	ARBORWAY	ROSLINDALE	20	20.17	3.18	15.76
850430	P	37.0	VERMONT	ROSLINDALE	15	15.13	4.11	27.16
850430	P	37.0	ARBORWAY	ROSLINDALE	15	15.71	1.28	8.14
850425	M	40.0	GEORGETOWNE	ROSLINDALE	30	27.50	6.58	23.92
850425	M	40.0	ARBORWAY	ROSLINDALE	30	30.33	9.57	31.55
850501	A	40.0	GEORGETOWNE	ROSLINDALE	30	30.00	3.67	12.23
850501	A	40.0	ARBORWAY	ROSLINDALE	30	31.67	0.94	2.96
850430	P	40.0	GEORGETOWNE	ROSLINDALE	20	20.40	1.02	5.00
850430	P	40.0	ARBORWAY	ROSLINDALE	20	19.83	2.61	13.16
850425	M	50.0	ARBORWAY	ROSLINDALE	20	18.00	1.41	7.83
850425	M	50.0	CLEARY SQUARE	ROSLINDALE	20	25.25	5.54	21.94
850501	A	50.0	CLEARY SQUARE	ROSLINDALE	20	20.33	2.21	10.87
850501	A	50.0	ARBORWAY	ROSLINDALE	20	20.14	1.46	7.24
850430	P	50.0	CLEARY SQUARE	ROSLINDALE	20	26.00	10.24	39.38
850430	P	50.0	ARBORWAY	ROSLINDALE	20	33.00	18.83	57.06
850425	M	51.0	CLEVELAND CIR	ROSLINDALE	30	31.00	2.35	7.58
850425	M	51.0	ARBORWAY	ROSLINDALE	30	39.33	6.24	15.86
850501	A	51.0	CLEVELAND CIR	ROSLINDALE	20	20.00	3.51	17.55
850501	A	51.0	ARBORWAY	ROSLINDALE	20	21.17	1.57	7.41

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850430	P	51.0	CLEVELAND CIR	ROSLINDALE	20	19.67	2.87	14.59
850430	P	51.0	ARBORWAY	ROSLINDALE	20	20.80	4.35	20.91
850426	A	53.0	ROBERTS	WALTHAM	60	62.00	6.00	9.67
850426	A	53.0	NEWTON CORNER	WALTHAM	60	122.00	24.00	19.67
850423	P	53.0	ROBERTS	WALTHAM	60	55.50	0.50	0.90
850423	P	53.0	NEWTON CORNER	WALTHAM	60	55.00	3.00	5.45
850510	M	53.0	ROBERTS	WALTHAM	60	59.00	6.00	10.16
850510	M	53.0	NEWTON CORNER	WALTHAM	60	59.50	1.50	2.52
850423	P	54.0	WAVERLY	WALTHAM	60	62.00	4.00	6.45
850423	P	54.0	NEWTON CORNER	WALTHAM	60	55.00	3.25	5.90
850426	A	54.0	NEWTON CORNER	WALTHAM	60	63.00	11.00	17.46
850426	A	54.0	WAVERLY	WALTHAM	60	33.00	9.27	28.09
850510	M	54.0	WAVERLY	WALTHAM	60	57.50	4.50	7.82
850510	M	54.0	NEWTON CORNER	WALTHAM	60	57.00	5.00	8.77
850423	P	56.0	NEWTON CORNER	WALTHAM	60	56.00	6.00	10.71
850423	P	56.0	WALTH HGHLNDS	WALTHAM	60	62.50	4.50	7.20
850426	A	56.0	NEWTON CORNER	WALTHAM	60	43.50	12.50	28.73
850426	A	56.0	WALTHM HGHLNDS	WALTHAM	60	29.50	23.50	79.66
850510	M	56.0	WALTHAM HGHLNDS	WALTHAM	60	62.00	10.00	16.12
850510	M	56.0	NEWTON CORNER	WALTHAM	60	63.50	7.50	11.81
850426	A	58.0	AUBURNDALE	WALTHAM	60	53.00	3.00	5.66
850423	P	58.0	NEWTON CORNER	WALTHAM	60	55.00	7.00	12.72
850426	A	58.0	NEWTON CORNER	WALTHAM	60	53.50	8.50	15.88
850423	P	58.0	AUBURNDALE	WALTHAM	60	40.50	15.50	38.27
850510	M	58.0	AUBURNDALE	WALTHAM	60	58.50	7.50	12.82
850510	M	58.0	NEWTON CORNER	WALTHAM	60	61.50	0.50	0.81
850509	M	60.0	KENMORE	BRKLN VILL	30	29.33	0.47	1.60
850509	M	60.0	CHESTNUT HILL	BRKLN VILL	30	23.75	11.41	48.04
850510	A	60.0	CHESTNUT HILL	BRKLN VILL	15	11.38	7.79	68.45
850510	A	60.0	KENMORE	BRKLN VILL	15	11.17	4.84	43.33
850507	P	60.0	CHESTNUT HILL	BKLN VILL	14	14.18	5.84	41.18
850507	P	60.0	KENMORE	BKLN VILL	15	15.40	10.52	68.31
850423	P	61.0	LEXINGTON	WALTHAM	60	70.00	12.50	17.85
850426	A	61.0	LEXINGTON	WALTHAM	60	66.00	8.61	13.00
850510	M	61.0	LEXINGTON CTR	WALTHAM	60	60.00	8.00	13.33
850509	M	65.0	BRIGHTON CTR	BRKLN VILL	30	28.75	2.77	9.63
850509	M	65.0	KENMORE	BRKLN VILL	30	23.00	7.32	31.82
850510	A	65.0	BRIGHTON CENTER	BRKLN VILL	20	21.33	1.25	5.86
850510	A	65.0	KENMORE	BRKLN VILL	21	20.50	2.60	12.68
850507	P	65.0	BRIGHTON CENTER	BKLN VILL	25	26.00	7.35	28.26
850507	P	65.0	KENMORE	BKLN VILL	25	26.50	3.20	12.07
850509	M	66.0	ALLSTON	BRKLN VILL	12	12.78	3.88	30.35
850509	M	66.0	DUDLEY STA	BRKLN VILL	12	13.13	4.46	33.96
850510	A	66.0	ALLSTON	BRKLN VILL	9	9.10	7.91	86.92
850510	A	66.0	DUDLEY	BRKLN VILL	9	9.20	6.87	74.67
850507	P	66.0	ALLSTON	BKLN VILL	10	9.87	3.98	40.32
850507	P	66.0	DUDLEY STATION	BKLN VILL	9	10.33	6.12	59.24
850426	A	70.0	CAMBRIDGE	WALTHAM	24	23.60	4.13	17.50
850426	A	70.0	CEDARWOOD	WALTHAM	26	24.33	7.13	29.30

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850423	P	70.0	CAMBRIDGE	WALTHAM	20	17.17	6.87	40.01
850423	P	70.0	CEDARWOOD	WALTHAM	20	19.00	10.23	53.84
850510	M	70.0	CAMBRIDGE	WALTHAM	30	30.67	0.94	3.06
850510	M	70.0	CEDARWOOD	WALTHAM	30	30.67	2.87	9.35
850509	P	76.0	HARVARD	PORTER SQ	30	30.67	6.94	22.62
850509	P	76.0	HANSCOM AFB	PORTER SQ	30	29.50	5.77	19.55
850503	A	76.0	HANSCOM AFB	PORTER SQ	30	30.00	4.00	13.33
850503	A	76.0	HARVARD	PORTER SQ	40	40.33	13.30	32.97
850425	M	76.0	HANSCOM AFB	PORTER SQ	60	61.00	7.34	12.03
850425	M	76.0	HARVARD	PORTER SQ	60	60.50	1.50	2.47
850509	P	77.0	HARVARD	PORTER SQ	4	5.00	2.24	44.80
850509	P	77.0	ARLINGTON HTS	PORTER SQ	4	3.88	1.97	50.77
850503	A	77.0	ARLINGTON HTS	PORTER SQ	3	4.36	2.51	57.56
850503	A	77.0	HARVARD	PORTER SQ	3	3.04	1.48	48.68
850425	M	77.0	ARLINGTON HTS	PORTER SQ	8	7.50	2.22	29.60
850425	M	77.0	HARVARD	PORTER SQ	8	8.50	4.32	50.82
850509	P	77.5	NORTH CAMBRIDGE	PORTER SQ	9	9.38	3.61	38.48
850509	P	77.5	HARVARD	PORTER SQ	9	7.00	2.94	42.00
850503	A	77.5	NORTH CAMBRIDGE	PORTER SQ	8	9.30	3.69	39.67
850503	A	77.5	HARVARD	PORTER SQ	10	10.45	1.83	17.51
850425	M	77.5	NORTH CAMBRIDGE	PORTER SQ	12	13.22	3.46	26.17
850425	M	77.5	HARVARD	PORTER SQ	12	13.00	2.83	21.76
850509	P	83.0	RINGE AVE	PORTER SQ	12	12.55	2.71	21.59
850509	P	83.0	CENTRAL SQUARE	PORTER SQ	12	13.63	2.50	18.34
850503	A	83.0	RINGE AVE	PORTER SQ	12	12.67	2.16	17.04
850503	A	83.0	CENTRAL SQUARE	PORTER SQ	8	8.69	3.10	35.67
850425	M	83.0	RINGE AVE	PORTER SQ	20	19.00	7.33	38.57
850425	M	83.0	CENTRAL SQUARE	PORTER SQ	20	22.33	7.91	35.42
850509	P	84.0	HARVARD	PORTER SQ	15	14.86	3.68	24.76
850509	P	84.0	ARLMONT VILLAGE	PORTER SQ	15	16.00	2.73	17.06
850503	A	84.0	ARLMONT VILLAGE	PORTER SQ	18	18.40	6.68	36.30
850503	A	84.0	HARVARD	PORTER SQ	15	15.43	0.90	5.83
850425	M	84.0	ARLMONT VILLAGE	PORTER SQ	20	20.00	0.82	4.10
850425	M	84.0	HARVARD	PORTER SQ	20	20.50	1.50	7.31
850501	A	87.0	ARLINGTON CTR	DAVIS SQ	20	16.80	4.79	28.51
850419	M	87.0	LECHMERE	DAVIS SQ	30	27.50	8.50	30.90
850501	A	87.0	LECHMERE	DAVIS SQ	16	23.17	7.80	33.66
850508	P	87.0	LECHMERE	DAVIS SQ	16	15.22	5.79	38.04
850508	P	87.0	ARLINGTON CTR	DAVIS SQ	15	13.90	6.33	45.53
850419	M	87.0	ARLINGTON CTR	DAVIS SQ	30	27.33	13.60	49.76
850501	A	88.0	LECHMERE	DAVIS SQ	7	9.78	2.94	30.06
850508	P	88.0	CLARENDON HILL	DAVIS SQ	13	12.50	3.88	31.04
850501	A	88.0	CLARENDON HILL	DAVIS SQ	7	11.00	3.74	34.00
850419	M	88.0	LECHMERE	DAVIS SQ	25	24.75	8.76	35.39
850508	P	88.0	LECHMERE	DAVIS SQ	16	14.22	5.24	36.84
850419	M	88.0	CLARENDON HILL	DAVIS SQ	25	27.25	12.03	44.14
850501	A	90.0	WELLINGTON	DAVIS SQ	30	28.50	0.50	1.75
850508	P	90.0	WELLINGTON STA	DAVIS SQ	35	35.25	1.30	3.68
850419	M	90.0	WELLINGTON STA	DAVIS SQ	33	30.50	8.50	27.86

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850419	M	94.0	MEDFORD/HIGH	DAVIS SQ	30	29.50	5.50	18.64
850501	P	94.0	HARVARD/HIGH	MEDFORD SQ	15	19.80	4.07	20.55
850426	M	94.0	HARVARD/HIGH	MEDFORD SQ	30	29.25	6.10	20.85
850501	A	94.0	HARVARD STA	DAVIS SQ	15	18.71	5.72	30.57
850501	A	94.0	MEDFORD SQ	DAVIS SQ	15	14.22	4.54	31.92
850508	P	94.0	HARVARD	DAVIS SQ	15	16.11	5.22	32.40
850423	A	94.0	HARVARD/HIGH	MEDFORD SQ	15	19.17	6.26	32.65
850419	M	94.0	HARVARD STA	DAVIS SQ	30	41.50	14.50	34.93
850508	P	94.0	MEDFORD/HIGH	DAVIS SQ	15	17.11	6.56	38.34
850509	P	94.0	HARVARD	PORTER SQ	15	14.63	3.71	25.35
850509	P	94.0	MEDFORD/HIGH	PORTER SQ	15	15.25	2.44	16.00
850503	A	94.0	MEDFORD/HIGH	PORTER SQ	15	15.86	1.81	11.41
850503	A	94.0	HARVARD	PORTER SQ	15	15.57	1.99	12.78
850425	M	94.0	MEDFORD/HIGH	PORTER SQ	30	31.50	3.28	10.41
850425	M	94.0	HARVARD	PORTER SQ	30	30.25	1.48	4.89
850426	M	95.0	WEST MEDFORD	MEDFORD SQ	30	30.25	1.64	5.42
850426	M	95.0	SULLIVAN STA	MEDFORD SQ	30	30.25	2.49	8.23
850423	A	95.0	SULLIVAN STA	MEDFORD SQ	15	15.13	3.06	20.22
850501	P	95.0	WEST MEDFORD	MEDFORD SQ	15	14.63	3.31	22.62
850423	A	95.0	WEST MEDFORD	MEDFORD SQ	15	18.20	6.18	33.95
850501	P	95.0	SULLIVAN STA	MEDFORD SQ	15	13.00	5.41	41.61
850419	M	96.0	HARVARD STA	DAVIS SQ	30	31.33	0.94	3.00
850419	M	96.0	MEDFORD/GEORGE	DAVIS SQ	30	30.33	2.05	6.75
850501	P	96.0	HARVARD/GEORGE	MEDFORD SQ	15	15.67	2.75	17.54
850426	M	96.0	HARVARD/GEORGE	MEDFORD SQ	30	24.40	6.28	25.73
850508	P	96.0	MEDFORD/GEORGE	DAVIS SQ	15	14.70	4.05	27.55
850501	A	96.0	HARVARD STA	DAVIS SQ	15	17.63	5.24	29.72
850508	P	96.0	HARVARD	DAVIS SQ	15	16.50	5.36	32.48
850501	A	96.0	MEDFORD SQ	DAVIS SQ	15	18.14	7.38	40.68
850423	A	96.0	HARVARD/GEORGE	MEDFORD SQ	15	15.29	8.51	55.65
850509	P	96.0	HARVARD	PORTER SQ	15	15.00	4.88	32.53
850509	P	96.0	MEDFORD/GEORGE	PORTER SQ	15	15.30	3.38	22.09
850503	A	96.0	MEDFORD/GEORGE	PORTER SQ	15	15.88	3.26	20.52
850503	A	96.0	HARVARD	PORTER SQ	15	15.88	1.54	9.69
850425	M	96.0	MEDFORD/GEORGE	PORTER SQ	30	30.75	0.83	2.69
850425	M	96.0	HARVARD	PORTER SQ	30	31.67	1.89	5.96
850417	M	97.0	WELLINGTON STA	MALDEN STA	60	60.00	0.00	0.00
850426	A	97.0	WELLINGTON	MALDEN STA	36	36.00	12.03	33.41
850509	P	97.0	WELLINGTON	MALDEN STA	30	30.00	0.82	2.73
850417	M	99.0	UPPER HIGHLAND	MALDEN STA	30	29.50	1.66	5.62
850417	M	99.0	WELLINGTON STA	MALDEN STA	30	30.00	1.73	5.76
850426	A	99.0	UPPER HIGHLAND	MALDEN STA	18	16.50	8.51	51.57
850426	A	99.0	WELLINGTON	MALDEN STA	23	21.71	4.37	20.12
850509	P	99.0	WELLINGTON	MALDEN STA	20	19.00	3.93	20.68
850509	P	99.0	UPPER HIGHLAND	MALDEN STA	20	19.57	2.38	12.16
850417	M	101.0	SULLIVAN STA	MALDEN STA	30	30.00	2.12	7.06
850426	M	101.0	SULLIVAN STA	MEDFORD SQ	30	32.25	2.86	8.86
850426	M	101.0	MALDEN STA	MEDFORD SQ	30	24.40	6.28	25.73
850423	A	101.0	MALDEN STA	MEDFORD SQ	22	15.86	5.44	34.30

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850501	P	101.0	SULLIVAN STA	MEDFORD SQ	11	11.00	4.00	36.36
850501	P	101.0	MALDEN STA	MEDFORD SQ	10	11.38	4.69	41.21
850423	A	101.0	SULLIVAN STA	MEDFORD SQ	13	8.69	6.17	71.00
850426	A	101.0	SULLIVAN	MALDEN STA	12	12.00	3.58	29.83
850509	P	101.0	SULLIVAN	MALDEN STA	12	12.27	3.39	27.62
850417	M	104.0	SULLIVAN STA	MALDEN STA	30	30.00	0.00	0.00
850426	A	104.0	SULLIVAN	MALDEN STA	12	13.22	4.76	36.00
850509	P	104.0	SULLIVAN/MAIN	MALDEN STA	16	16.00	1.83	11.43
850417	M	105.0	SULLIVAN STA	MALDEN STA	60	60.00	0.00	0.00
850426	A	105.0	SULLIVAN	MALDEN STA	30	31.00	1.22	3.93
850509	P	105.0	SULLIVAN/FLKNER	MALDEN STA	38	37.50	13.01	34.69
850417	M	106.0	LEBANON	MALDEN STA	30	29.80	2.04	6.84
850417	M	106.0	WELLINGTON STA	MALDEN STA	30	31.25	5.54	17.72
850426	A	106.0	WELLINGTON	MALDEN STA	21	19.57	2.72	13.89
850426	A	106.0	LEBANON	MALDEN STA	20	19.00	7.48	39.36
850509	P	106.0	WELLINGTON	MALDEN STA	20	19.00	2.20	11.57
850509	P	106.0	LEBANON	MALDEN STA	20	19.71	1.98	10.04
850417	M	108.0	LINDEN	MALDEN STA	30	30.00	2.24	7.46
850417	M	108.0	WELLINGTON STA	MALDEN STA	30	29.40	2.80	9.52
850426	A	108.0	WELLINGTON	MALDEN STA	20	20.50	6.02	29.36
850426	A	108.0	LINDEN SQUARE	MALDEN STA	26	23.40	7.34	31.36
850509	P	108.0	WELLINGTON	MALDEN STA	21	24.83	8.07	32.50
850509	P	108.0	LINDEN	MALDEN STA	20	19.75	1.56	7.89
850417	M	130.0	WYOMING	MALDEN STA	60	58.50	0.50	0.85
850417	M	130.0	LEBANON	MALDEN STA	60	57.50	1.50	2.60
850426	A	130.0	LEBANON	MALDEN STA	30	29.67	1.25	4.21
850426	A	130.0	WYOMING	MALDEN STA	30	29.60	1.02	3.44
850509	P	130.0	LEBANON	MALDEN STA	30	30.00	0.71	2.36
850509	P	130.0	WYOMING	MALDEN STA	30	30.00	0.00	0.00
850417	M	131.0	MELROSE HLDS	MALDEN STA	60	60.00	0.00	0.00
850426	A	131.0	MELROSE HGHLNDS	MALDEN STA	30	29.75	1.09	3.66
850509	P	131.0	MELROSE HGHLNDS	MALDEN STA	30	30.00	0.00	0.00
850501	P	134.0	WNTHRP ST/N WOB	MEDFORD SQ	20	21.00	1.73	8.23
850426	M	134.0	WNTHRP ST/N WOB	MEDFORD SQ	30	30.50	4.50	14.75
850426	M	134.0	WELLINGTON STA	MEDFORD SQ	30	31.67	7.41	23.39
850501	P	134.0	WELLINGTON STA	MEDFORD SQ	20	17.80	4.17	23.42
850423	A	134.0	WELLINGTON	MEDFORD SQ	24	16.67	9.98	59.86
850423	A	134.0	WINTHROP/N WOB	MEDFORD SQ	24	14.50	11.40	78.62
850417	M	136.0	READING SQUARE	MALDEN STA	30	30.00	0.00	0.00
850426	A	136.0	READING SQUARE	MALDEN STA	28	27.00	6.98	25.85
850509	P	136.0	READING SQUARE	MALDEN STA	25	25.00	5.00	20.00
850423	P	305.0	DOWNTOWN BOSTON	WALTHAM	14	12.70	7.09	55.82
850426	A	305.0	DOWNTOWN BOSTON	WALTHAM	10	10.08	6.03	59.82
850501	A	315.0	BACK BAY BOSTON	ROSLINDALE	30	31.50	0.50	1.58
850423	A	326.0	BOSTON VIA I-93	MEDFORD SQ	13	13.00	2.61	20.07
850501	P	326.0	WEST MEDFORD	MEDFORD SQ	15	12.88	4.48	34.78
850509	P	350.0	BURLINGTON	PORTER SQ	24	22.60	6.74	29.82
850509	P	350.0	BOSTON LIMITED	PORTER SQ	30	20.00	0.00	0.00
850503	A	350.0	BURLINGTON	PORTER SQ	30	32.00	0.82	2.56

DATE	TIME	ROUTE	DIRECTION	LOCATION	SCHEDULED HEADWAY	OBSERVED HEADWAY	STANDARD DEVIATION	COVARIANCE OF HEADWAY
850503	A	350.0	BOSTON	PORTER SQ	13	12.38	3.71	29.96
850425	M	350.0	BURLINGTON	PORTER SQ	60	62.00	1.00	1.61
850425	M	350.0	BOSTON	PORTER SQ	60	60.50	4.50	7.43
850417	M	411.0	REVERE BEACH	MALDEN STA	60	30.00	0.00	0.00
850426	A	411.0	REVERE BEACH	MALDEN STA	51	50.00	11.34	22.68
850509	P	411.0	REVERE BEACH	MALDEN STA	45	44.67	1.25	2.79
850417	M	430.0	SAUGUS	MALDEN STA	60	57.00	2.00	3.50
850426	A	430.0	SAUGUS	MALDEN STA	50	49.00	13.74	28.04
850509	P	430.0	SAUGUS	MALDEN STA	44	42.50	2.29	5.38

APPENDIX I

SAMPLE RUNNING TIME SHEET

07

CITY POINT - FRANKLIN & DEVONSHIRE STREETS

South Boston turnaround, l. E. First Street, r. P Street, r. E Fourth, r. L Street to Summer, r. Viaduct, r. Ramp, l. Northern Ave., l. Sleeper, r. Congress, l. Dorchester Ave., r. Summer Street, Dewey Square, r. High Street, l. Federal, l. Franklin.

RETURN: l. Franklin, l. Otis, l. Summer, l. Dorchester Ave., r. Congress, l. Sleeper, r. Northern Ave., r. D Street Ramp, l. Viaduct, l. Summer to L Street, l. Broadway, l. Farragut Road, l. E. First Street, r. South Boston turnaround.

WEEKDAY	7:00AM–8:59AM IN	OUT	9:00AM–2:29PM IN	OUT	2:30PM–7:30PM IN	OUT
City Point - South Station	18	14	16	13	17	14
South Station - Franklin & Devonshire Streets	4	6	4	6	5	8
	22	20	20	19	22	22
ROUND TRIP		42		39		44

SATURDAY	7:30AM–11:29AM IN	OUT	11:30AM–7:30PM IN	OUT
City Point - South Station	16	13	17	15
South Station - Franklin & Devonshire Streets	4	6	4	6
	20	19	21	21
ROUND TRIPS		39		42

SPRING 1986 (R)

CABOT GARAGE
3/29/86

SAMPLE MBTA TIMETABLE RUN SHEET

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                HOLIDAY          MASSACHUSETTS BAY TRANSPORTATION AUTHORITY TIMETABLE                                         FEB 2 1986
                                                                                                                              B 6 2 3
PAGE NO. 1      WEEKDAY       EFFECTIVE DATE  03/31/86 JUN 17 1986  CABOT  GARAGE              CABOT  RATING STATION     TIMETABLE NO.B122
                   RUNS ARE FIGURED AT MAXIMUM RATE - LOWER RATE OPERATORS ARE PAID AT THEIR OWN RATE
                                                       CABOT W

1001  427A C      23-   23-   23-   23-   23-   23-              C        60-   60-   60-
         X 437A    •    508   552   636   731   826   929-......X 953      •   1050  1150                 1219P  742                742
                  449   528   612   658   755   850        C            1020  1120    A                                         108.64
1002  423A C      66-   66-   66-   66-   66-   66-   66-                        23-   23-   23-
         X 433A    •    502   547   629   724   824   929  1006 ...... 1038       •   1105  1157      • 1231P  758          08     758
                  445   525   608   655   755   857    A                         1039  1131    A      C                    2.72  111.38
1003  422A C      10-   10-   10-   08-   08-   10-   10-   08-   08-   10-               C
         X 432A    •    504   550    •    638    •    730    •    818    •    914-......X 945  - - -
                  444   525    A    620    A    700    A    800    A    840.     C
                                                                  15-   15-   15-   15-   15-
                                                          - - -  1000  1030  1100  1130  1200N     • 1236P  804          14     804
                                                                  --    --    --    --    --       C                    4.75  113.39
1004  430A C      22-   22-   22-   22-   22-              C      66-   66-   66-
         X 440A   501   545   632   728   825   932-......X1002    •   1053  1203P    -                1241P  801          11     801
                  521   603   654    --   851     C            1021  1131    A      C                                   3.73  112.37
1005  433A C      43-   43-   43-   43-   43-              C      45-   45-   44-   44-   45-
         X 443A   500   550   640   735   834   938-......X1009    •   1046    •   1117    •   - - -
                   --    --    --    --   901     C            1028    A   1102    A   1132
                                                                              45-   44-   44-
                                                                      - - -  1150    •   1221      • 1246P  803          13     803
                                                                               A   1206P    A      C                    4.41  113.05
1006  439A C      01-   01-   01-   01-   01-                      45-   45-   44-   44-   45-
         X 445A    •    530   647   806   930  1014 ...... 1043      •   1102    •   1133    •   - - -
                  457   608   726   851    A                       1044    A   1118    A   1148
                                                                                    45-   44-
                                                                            - - -  1206P    •      • 1248P  803          13     803
                                                                                     A   1222      C                    4.41  113.05
1007  440A C      47-   47-   47-   47-   47-              C      15-   15-   15-   15-
         X 450A    •    530   640   800   920  1003-......X1030  1045  1115  1145  1215P    •          1251P  801          11     801
                  500   600   720   840    A      C              --    --    --    --      C                            3.73  112.37
1008  441A C      17-   17-   17-   17-   17-   17-   17-   17-               C        22-   22-
         X 451A    •    510   540   610   640   725   810   855   915-......X 947       •   1032  - - -
                  455   525   555   625   702   747   832    A        C                1006  1058
                                                                                     22-   22-
                                                                             - - -  1124  1216P     • 1251P  800          10     800
                                                                                    1150    A       C                    3.40  112.04
1009  439A C      16-   16-   16-   163   162   162              C        44-   44-   45-   45-
         X 449A   503   537   611    •    700   815   955-......X1027      •   1101    •   1134  - - -
                  520   554    A    630   740   855        C            1046    A   1116    A
                                                                           44-   44-   45-   45-
                                                                  - - -     •   1205P    •   1238          1253P  804          14     804
                                                                          1150    A   1220    A                              4.75  113.39
1010  444A C      603   60-   60-   60-   60-              C      22-   22-   22-   22-
         X 454A    •    525   615   726   834   923-......X1000    •   1045  1137  1229                   1254P  800          10     800
                  510   550   650   758    A      C              1019  1111  1203P    A                                     3.40  112.04
1011  525A C      55-   551   551   551   551                C        01-   01-   01- 90281
         X 535A    •    600   644   733   823   851-         X1016A    •   1120  1250                •   257P  922          07     757
                  550    --    --   752    A      C                  1035  1205PE   A               C                    2.38  111.02
1012  551A C      47-   47-   47-   47-                    C      23-   23-   23-   23-
         X 601A   620   740   900  1020  1103•           X1204P    •   1249   141   233    •              307P  906          15     805
                  700   820   940    A      C                  1223   115   207    A     C                                5.09  113.73
1013  451A C      45-   45-   45-   45-   45-   45-   45-   45-   45-   45-   44-   44-
         X 501A   515   542   605   634   710   742   814   848   918   958    •   1029  1043  - - -
                  529   556    --    --    --    --    --    --   940    A   1014    A
                                                                         65-   65-   60-   60-
                                                  - - -         1249P     •    125    •    235            309P 1008     20    12     802
                                                                        1250     A    200    A                  .90   4.53  4.07  118.14

                  CA, .
```

TIMETABLE B112B-EFFECTIVE 04/01/85
FELLSWAY GARAGE

LEAVE	FROM	RTE	FOLLOWING TRIP TIME	AT	RTE	RUNNING TIME ALLOWANCE	RUN SHEET ACTUAL	LAYOVER TIME	LAYOVER/ RUNNING RATIO
RUN: 107									
5 5	SAL	101	5 25	SUL	1013	17	20	3	15.0%
5 25	SUL	1013	6 0	MAL	1013	22	35	13	37.1%
6 0	MAL	1013	6 25	SUL	1013	22	25	3	12.0%
6 25	SUL	1013	7 0	MAL	1013	26	35	9	25.7%
7 0	MAL	1013	7 33	SUL	104	29	33	4	12.1%
7 33	SUL	104	8 3	GARAGE		22	30	8	26.7%
PULLOUT									
10 10	WEL	1345	11 8	WOB	1345	47	58	11	19.0%
11 8	WOB	1345	12 10	WEL	1345	44	62	18	29.0%
12 10	WEL	1345	13 8	WOB	1345	47	58	11	19.0%
13 8	WOB	1345	14 10	WEL	997	44	62	18	29.0%
14 10	WEL	997	14 40	UPH	997	28	30	2	6.7%
14 40	UPH	997	15 15	GARAGE		25	35	10	28.6%
								MEAN:	22.8%

TIMETABLE B122-EFFECTIVE 04/01/85
CABOT GARAGE

LEAVE	FROM	RTE	FOLLOWING TRIP TIME	AT	RTE	RUNNING TIME ALLOWANCE	RUN SHEET ACTUAL	LAYOVER TIME	LAYOVER/ RUNNING RATIO
RUN: 1106									
11 0	AND	18	11 30	ASH	18	21	30	9	30.0%
11 30	ASH	18	12 0	AND	18	21	30	9	30.0%
12 0	AND	18	12 30	ASH	18	21	30	9	30.0%
12 30	ASH	18	13 0	AND	18	21	30	9	30.0%
13 0	AND	18	13 30	ASH	18	21	30	9	30.0%
13 30	ASH	18	13 55	GARAGE		21	25	4	16.0%
PULLOUT									
15 42	CTY	47	16 24	CEN	47	31	42	11	26.2%
16 24	CEN	47	17 12	CTY	47	33	48	15	31.3%
17 12	CTY	47	17 54	CEN	47	31	42	11	26.2%
17 54	CEN	47	18 30	CTY	47	24	36	12	33.3%
18 30	CTY	47	19 0	CEN	47	22	30	8	26.7%
19 0	CEN	47	19 30	CTY	47	24	30	6	20.0%
19 30	CTY	47	20 0	CEN	47	22	30	8	26.7%
20 0	CEN	47	20 34	GARAGE		24	34	10	29.4%
								MEAN:	27.8%

TIMETABLE B172-EFFECTIVE 04/01/85
LYNN GARAGE

LEAVE	FROM	RTE	FOLLOWING TRIP TIME	AT	RTE	RUNNING TIME ALLOWANCE	RUN SHEET ACTUAL	LAYOVER TIME	LAYOVER/ RUNNING RATIO
RUN: 1047									
9 30	MAV	1175	10 18	WON	1175	24	48	24	50.0%
10 18	WON	1175	10 50	MAV	1175	23	32	9	28.1%
10 50	MAV	1175	11 29	GARAGE		34	39	5	12.8%
PULLOUT									
13 45	ORH	120	14 15	MAV	120	21	30	9	30.0%
14 15	MAV	120	14 45	ORH	120	23	30	7	23.3%
14 45	ORH	120	15 15	MAV	120	21	30	9	30.0%
15 15	MAV	120	15 45	ORH	120	23	30	7	23.3%
15 45	ORH	120	16 15	MAV	120	21	30	9	30.0%
16 15	MAV	120	16 45	ORH	120	23	30	7	23.3%
16 45	ORH	120	17 15	MAV	120	21	30	9	30.0%
17 15	MAV	120	17 50	ORH	120	23	35	12	34.3%
17 50	ORH	120	18 15	MAV	120	20	25	5	20.0%
18 15	MAV	120	18 57	GARAGE		38	42	4	9.5%
								MEAN:	26.9%

TIMETABLE B132-EFFECTIVE 04/01/85
SOMERVILLE DIVISION-CHARLESTOWN GARAGE

LEAVE	FROM	RTE	FOLLOWING TRIP TIME	AT	RTE	RUNNING TIME ALLOWANCE	RUN SHEET ACTUAL	LAYOVER TIME	LAYOVER/ RUNNING RATIO
RUN: 1026									
6 15	HVD	76	7 15	AFB	76	51	60	9	15.0%
7 15	AFB	76	8 15	HVD	76	50	60	10	16.7%
8 15	HVD	76	9 15	AFB	76	51	60	9	15.0%
9 15	AFB	76	10 14	GARAGE		48	59	11	18.6%
PULLOUT									
12 50	KEN	85	13 10	SPH	85	12	20	8	40.0%
13 10	SPH	85	13 30	KEN	85	12	20	8	40.0%
13 30	KEN	85	13 50	SPH	85	12	20	8	40.0%
13 50	SPH	85	14 10	KEN	85	12	20	8	40.0%
14 10	KEN	85	14 30	SPH	85	12	20	8	40.0%
14 30	SPH	85	14 50	KEN	85	12	20	8	40.0%
14 50	KEN	85	15 10	SPH	85	12	20	8	40.0%
15 10	SPH	85	15 30	KEN	85	12	20	8	40.0%
15 30	KEN	85	15 50	SPH	85	12	20	8	40.0%
15 50	SPH	85	16 14	GARAGE		12	24	12	50.0%
								MEAN:	27.8%

APPENDIX J

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

To: Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board

Through: John K. Leary, Jr.
Director of Operations

From: Paul J. Lennon
Chief Transportation Officer

Date: January 2, 1986

SUBJECT: INTENDED ROLE AND FUNCTIONS OF AUTHORITY CHIEF INSPECTORS AND INSPECTORS

Per your interoffice memo of December 16, 1985, an outline of the intended role and functions of Authority Inspectors and Chief Inspectors is as follows:

A. The role of Inspectors/Chief Inspectors as it relates to the maintenance of headways.

First line officials are expected to assert their initiative in maintaining proper service levels to and from their point of responsibility. They also report reasons for delays (traffic, weather, construction, etc.) to the Central Control Dispatcher in order that remedial actions may be taken. Officials are required to make minor repairs to vehicles to keep them in service until a substitute vehicle is dispatched. They assist operators in coping with ill or unruly passengers, thus averting prolonged delays; they assess and report on ridership levels so that more effective service may be planned and scheduled; they act as informational points for both Authority employees and riders and they are responsible for protecting the physical plant in their area of responsibility. Inspectors/Chief Inspectors also report defects such as graffiti, etc.

B. The tools at their disposal (radios, cars, etc.).

All officials are equipped with keys for access to the physical plant, police type restraint devices, schedules, telephones to report incidents and, when available, two-way radios. Chief Inspectors use automobiles that make it possible to go directly to the scene of a delay (i.e., fire, accident) and reroute buses by it. They also use these vehicles to monitor bus movements on routes, check road conditions during adverse weather, and sometimes push a disabled bus or trackless trolley out of the regular traffic flow. These vehicles are also used to spot-check individual operators.

C. Amount of testing, training and retraining related specifically to their transportation function.

The following five (5) requirements must be met in order to become an Inspector/Chief Inspector:

TRS-119

1. Communications and writing skills as normally attained through a four year High School program or educational equivalent.

2. Knowledge of MBTA service operations obtained from full-time employment as an Operator.

3. Passing grade on the Authority examination for Inspector and successful completion of the Inspectors' Training Program.

4. Ability to handle crisis situations in a calm and efficient manner.

5. Interpersonal skills needed to handle situations involving potentially irate patrons while protecting the rights and property of the Authority.

Note: Chief Inspectors must have passed the MBTA test for Inspector and also the Inspectors' Training Program

In the Fall of 1983, the Authority offered a three week training program for Chief Inspectors, as well as Inspectors. The goal of this retraining program was to recertify them as badged Railway Police Officers. Not withstanding their obligations as Chief Inspectors and Inspectors in keeping the system operating on schedule and efficiently, they have the additional responsibility of maintaining public safety on the MBTA property and vehicles. The Railway Police Officer is charged with prevention of crime on all the property of the MBTA and may arrest those who violate the law on the premises, stations, trains, streetcars, buses, and trackless trolleys. He has the same powers to arrest violators of the law on the MBTA as a regular city Police Officer, in addition to his Transportation duties.

The Authority also provides an annual five day retraining program which includes both classroom and "hands-on" training in the following:

. Investigative report writing.
. Persuasion devices and handcuffs.
. Fire prevention and protection.
. Equipment familiarization.
. Overcoming mechanical problems.
. Emergency procedures.
. Vehicle evacuation.
. Circle checks.
. Handling accidents.
. Cardiopulmonart resuscitation.
. Office terminology.
. Industrial accidents and reports.

D. Examples of forms used while performing their jobs - see attached.

E. The disciplinary code followed by supervisory personnel in monitoring the performance of surface operations:

Chief Inspectors and Inspectors represent the Authority's management to operating employees and are, in fact, the Authority's eyes and ears in the field. They are responsible for insuring compliance with all rules, regulations and special orders by employees in their charge and for taking corrective measures when subordinates commit infractions.

First line supervisors are expected to lead both by performance and example. Their work is carefully scrutinized by senior management staff as these positions carry heavy responsibility and are considered to be important steps in a successful career path with the Authority.

Additionally, these officials keep our patrons informed of delays and advise them of their probable duration. Alternate routes are often explained by them. Bus operators are basically only aware of operational difficulties involving their own route and vehicles; therefore, this information and advice cannot be offered by them.

The experience of the Transportation Department bears out your theory that assigning first line supervisory personnel at bus departure points leads to improved service reliability out of these points. The primary reason for this lies in the fact that Inspectors/Chief Inspectors become aware of delays on routes which are not immediately apparent to operators nor to Central Control Dispatchers. Acting on this knowledge, our officials are able to reroute vehicles from other lines to lessen longer headways on delayed routes or to express vehicles to other points along a line to restore overall service continuity.

Please let me know if I may be of any further assistance in this matter.

PJL/rt

APPENDIX K

MBTA Advisory Board

120 Boylston Street, Suite 504, Boston, Massachusetts 02116 Tel. 617-426-6054

4 December, 1985

Mr. Richard C. Clair, Operating Manager
Tidewater Regional Transit
509 East 18th Street
Norfolk, VA 23501

Dear Mr. Clair:

As part of a current effort to improve MBTA bus service reliability, we are soliciting response from large bus properties concerning field supervision of bus operations. To help us in our endeavor, kindly describe the methods used by TRT to monitor bus schedule adherence and operator driving habits.

Please include details of the role played by key operating personnel (i.e. starters, street supervisors, inspectors, TRT drivers, etc.) and the tools at their disposal, examples of forms used by field personnel, and the use of automatic vehicle monitoring devices at TRT.

Your assistance in this matter will be highly appreciated. I remain,

Sincerely,

Andrew J. Tsihlis,
Operations Analyst

TRANSIT AGENCIES SURVEYED

Albany	NY	Capital District Transportation Authority
Atlanta	GA	Metropolitan Atlanta Rapid Transit Authority
Baltimore	MD	Mass Transportation Administration
Birmingham	AL	Metro Area Express, Inc.
Boston	MA	Massachusetts Bay Transportation Authority
Buffalo	NY	Niagara Frontier Transportation Authority
Calgary	AB	Calgary Transit System
Charlotte	NC	Charlotte Transit System
Chicago	IL	Chicago Transit Authority
Cincinnati	OH	Southwest Ohio Regional Transit Authority
Cleveland	OH	Greater Cleveland Regional Transit Authority
Columbus	OH	Central Ohio Transportation Authority
Dallas	TX	Dallas Transit System
Dayton	OH	Miami Valley Regional Transit Authority
Denver	CO	Denver Regional Transit District
Des Moines	IA	Metropolitan Transit Authority
Detroit	MI	Southeastern Michigan Transportation Authority
Edmonton	AB	Edmonton Transit System
Fort Lauderdale	FL	Broward County Transportation Administration
Fort Worth	TX	CITRAN
Halifax	NS	Halifax-Dartmouth Transit System
Hartford	CT	Connecticut Transit (Hartford Division)
Honolulu	HA	MTL, Inc (The Bus)
Houston	TX	Metropolitan Transit Authority of Harris County
Indianapolis	IN	Indianapolis Public Transit Corporation
Jacksonville	FL	Jacksonville Transportation Authority
Kansas City	MO	Kansas City Area Transportation Authority
Los Angeles	CA	Southern California Regional Transit District
Louisville	KY	Transit Authority of River City
Madison	WI	Madison Area Metro Transit
Marin County	CA	Golden Gate Transit District
Memphis	TN	Memphis Area Transit Authority
Miami	FL	Dade County Transportation Administration
Milwaukee	WI	Milwaukee County Transit Authority
Minneapolis/St. Paul	MN	Metropolitan Transit Commission
Montreal	PQ	Societe de Transpt de la Communaute Urbaine de Montreal
Nashville	TN	Metropolitan Transit Authority
Nassau County	NY	Metropolitan Suburban Bus Authority
New Jersey-Statewide	NJ	New Jersey Transit Bus Operations, Inc.
New Orleans	LA	New Orleans Regional Transit Authority
New York City	NY	New York City Transit Authority
Norfolk	VA	Tidewater Transportation District Commission
Northern Kentucky	KY	Transit Authority of Northern Kentucky
Oakland	CA	Alameda-Contra Costa County Transit District
Omaha	NE	Metro Area Transit
Orange County	CA	Orange County Transit District
Ottawa	ON	Ottawa-Carleton Regional Transit Authority
Philadelphia	PA	Southeastern Pennsylvania Transportation Authority
Phoenix	AZ	Phoenix Transit System
Pittsburgh	PA	Port Authority of Allegheny County Transit Authority
Portland	OR	Tri-County Metropolitan Transit District of Oregon

Providence	RI	Rhode Island Public Transit Authority
Quebec	PQ	Commission de Transport de la Comnte Urbaine de Quebec
Richmond	VA	Greater Richmond Transit Authority
Rochester	NY	Rochester-Genessee Regional Transit Service
Sacramento	CA	Sacramento Regional Transit District
Salt Lake City	UT	Utah Transit Authority
San Antonio	TX	VIA Metropolitan Transit System
San Diego	CA	San Diego Transit Corporation
San Francisco	CA	San Francisco Municipal Railway
San Jose	CA	Santa Clara County Regional Transit District
San Juan	PR	Autoridad Metropolitana de Autobuses
Seattle	WA	Municipality of Metropolitan Seattle Transit
Spokane	WA	Spokane Transit Authority for Regional Transportation
Springfield	MA	Pioneer Valley Transit Authority
St. Louis	MO	Bi-State Development Agency
Syracuse	NY	Central New York Regional Transportation Authority
Tacoma	WA	Peirce County Transit Authority
Tampa/St. Petersburg	FL	Hillsborough County Regional Transit Authority
Toledo	OH	Toledo Area Regional Transit Authority
Toronto	ON	Toronto Transit Commission
Tucson	AZ	Suntran
Vancouver	BC	BC Transit
Washington	DC	Washington Metropolitan Area Transit Authority
White Plains	NY	Westchester County Department of Transportation
Wilmington	DE	Delaware Administration for Regional Transportation
Winnipeg	MB	Winnipeg Transit System

SAMPLE RESPONSES

San Juan, Puerto Rico

Commonwealth of Puerto Rico
Department of Transportation and Public Works
Metropolitan Bus Authority
P.O. Box 2339, Hato Rey, Puerto Rico 00919 2339
Cable AMA • Telex AUTOBUS 3450827

All correspondence should be addressed to the
PRESIDENT AND GENERAL MANAGER

No 50-016008
Please mention this number when referring to this subject.

January 14, 1986

Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street
Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihlis:

This is in response to your letter which we received on December 10, 1985, requesting a description of the methods used by the Metropolitan Bus Authority to monitor bus schedule adherence and operator driving habits.

We are enclosing a description of said information, and examples of the forms used by some of our key operating personnel.

We hope this information is helpful to you in your works. If you have any further questions, please do not hesitate to contact us.

Cordially,

Mario A. Prieto Batista
President and General Manager

Enclosures

Transit Supervisors

The functions performed by these supervisors are of great importance to our organization; they are considered the "eyes" of our agency in the field. Through their observations and suggestions we verify that the service is given as was programmed, recognize any problems affecting our users, drivers and dispatchers; and coordinate with other agencies any solution to problems that might affect the service.

The majority of the Supervisors duties are common to those which occupy this position. Nevertheless, some vary according to their work areas, which might be routes, terminals or garage.

A. Route Supervisors:

1. Inform route service conditions
2. verify that the drivers travel through the route established in the schedule.
3. Make any necessary deviation to routes which may be caused by any obstruction in the transit route way, keeping in mind user needs.
4. Inform any adverse condition of the roads and/or agency facilities.
5. Make any necessary schedule changes in coordination with the Radio Communication Center.
6. Inspect terminals that are in their working area. Verify that the service rendered is as established in the schedules.

B. Garage Supervisors:

The Garage Supervisors' work is vital in providing a good service, since this person is responsible for seeing that units are on service at the indicated time and amounts.

1. They should be aware of the amount of units available for service.
2. They coordinate with the maintenance supervisors the repair of units according to any defects reported and the preventive maintenance schedule.
3. How many runs are available.
4. Instruct Dispatchers of any necessary schedule adjustments.
5. Assign units to drivers with no previously assigned units. This is done in coordination with the Radio Communication Center, so that they may also make adjustments, if necessary.
6. Verify that all units which are used to give service, as those which may return because of any defects, are accounted for.

Page 2
Transit Supervisors

7. Be in communication with other terminals and supervisors as to offer any necessary assistance (referring to the service).

C. Terminal Supervisors:

These supervisors have more or less the same functions, in addition, they also:

1. dispatch units according to schedules
2. be helpful to our users in any possible way
3. fill out their work forms accordingly

All supervisors must make sure that all the agencies norms and regulations be properly executed by drivers and dispatchers.

Dispatchers

1. Supply drivers with their run cards.
2. Sign each drivers run card at the end of each work-day period.
3. Write down in the check down sheet the arrival and departure time of each unit as per the pre-assigned run number.
4. Dispatch drivers as per scheduled.
5. Complete required information on the "relief sheet".
6. Monitor bus schedule adherence.
7. Offer information and assistance to the public.
8. Cover any open run with substitute drivers.

Communication System

Bus Monitoring

This system calculates vehicle location via an odometer on a vehicle wheel, and then passes on this information in the form of digital data. It can provide automatic vehicle identification, emergency status alert, passenger count, radio channel control, and bus mechanical system monitoring.

Each bus is equipped with a microprocessor-based mobile data control head and two-way radio, allowing the transmission of digitally encoded data to and from the control center. A central computer polls every bus once a minute at a rate of five buses per second. When the driver starts out on each run, he enters his route/run number into the control head and transmits it to the computer, where it is assigned with the scheduled route assignments.

Page 3
Transit Supervisors

If a driver wishes to communicate with the controller, he presses a request-to-talk button which sends his route/run code over the radio channel to the control center, where it is displayed on a cathode ray tube screen.

As other buses make requests to talk, a stacking system forms a queue. When a driver enters a talk request, an acknowledge lamp on the bus's control head lights up. As the request is received at the center, the computer sends out an acknowledge message that extinguishes the lamp. The lamp remains on until the request is acknowledged by the central computer.

When the controller calls the bus, a beeper alerts the driver to pick up his handset. As soon as he responds, his bus identification code is automatically transmitted each time the push-to-talk switch is depressed.

Bus service has always been vulnerable to disruption caused by breakdowns, with engine failures being the most costly in terms of both disruption and repair expense. The system approaches this problem by providing advance warning of mechanical failures through the use of sensors to monitor oil pressure, etc. If an alarm is activated in the bus, a digital message is automatically sent to the computer and shown in the CRT, alerting the controller to take appropriate action; for instance, stopping the driver and arranging for a replacement bus to take passengers to their destination and sending mechanics or a tow truck.

To counter the increasing possibility of violence or robbery aboard buses, a hidden alarm switch has been fitted in each driver's cab. If the need arises, it transmits a message to base within five seconds, allowing the controller to determine the approximate location of the vehicle along its route, and to alert the police.

For public transit companies, it is often a laborious and time-consuming process to record and analyze exact passenger statistics. Yet without this eseential data, it is practically impossible to gauge the cost-effectiveness of a given service. The system in use in Puerto Rico goes a long way towards solving this problem.

While out on a route, drivers keep track of the number of passengers boarding their vehicle using a mechanical accumulator counter. This counter can differentiate between five different fare categories. At the end of each journey, drivers transmit this information to the base computer via the digital control head. Weekly productivity reports can then be generated with limited manual intervention. The system also allows the generation of daily mileage reports per route or bus.

Upon implementing the system, MBA has considerably improved its schedules on all its routes. This advanced system, together with the recent acquisition of 91 new advanced-design buses, has given the authority a substantial improvement in the service provided.

Controller:

The controller is responsible for operating the radio system.

Drivers:

Offer user service as determined by route schedules, which are described in the driver run cards.

San Antonio, Texas

Metropolitan Transit

December 12, 1985

Mr. Andrew J. Tschlis
M.B.T.A. Advisory Board
120 Boylston Street
Suite #504
Boston, Massachusetts 02116

Dear Mr. Tschlis:

This letter is in response to your questions regarding the method used by VIA to monitor bus operations.

VIA is currently involved in two projects which should be completed next year that will upgrade our data collection and analysis efforts.

The first is a project contracted to General Railway Systems, to install a radio communication and AVM System.

The second project contracted to Multisystems, Inc., is the installation of a data collection/data analysis system. This system will utilize hand-held computers for data collection that will interface with our Mini-Scheduler.

Since neither of these projects are operational at this time, I will confine the remainder of this letter to present monitoring procedures.

Our bus operator to dispatcher communication is accomplished through the use of direct phone lines to the dispatchers office. These phones are located at all end-of-lines and relief points. The operator is required to call in at the scheduled departure time from the end-of line location. The dispatcher records the actual time of the call on the "train sheet", which shows all scheduled departures for that day's operation.

If the call is recieved three minutes late or over, the dispatcher records the reason, given by the operator, for the delay. These sheets are analyzed and a monthly end-of-line schedule adherence report is compiled. This information can be used as a primary check for schedule problems on a line; however it only identifies significant problems, since the call occurs on the departure time, after any scheduled recovery time.

800 West Myrtle, P.O. Box 12489, San Antonio, Texas 78212 (512) 227-5371

Mr. Andrew J. Tschlis
M.B.T.A. Advisory Board
120 Boylston Street
Suite #504
Boston, Massachusetts 02116

VIA currently employs eight schedule checkers, who are responsible for the majority of our data collection. Each month these checkers perform an all-day time and load check at the maximum load point for every line. These checks are used to compile a monthly schedule performance report, which shows average loads and on-time performance by time periods. The schedule checkers are also used to conduct load checks and ride checks required to obtain more detailed information for schedule revisions.

In addition to the schedule checkers, there are fifteen line supervisors that also perform time and load checks. The supervisors main function is to check and correct operator infractions; however the data they collect is also used for schedule performance analysis.

Our Money Counting Division also prepares a weekly report of daily passenger estimates by line, which is calculated through the use of an average fare per passenger formula, based on each lines daily farebox receipts. The average fare per passenger, for each line, is established and updated by sample farebox checks and fare category counts conducted throughout the year.

As another means of identifying problems, we have an Operators Suggestion Committee, which consists of nine bus operators. At a monthly meeting, these operators report directly to various department representatives any problems or suggestions for improvements to bus operations.

Another source of information is our Customer Assistance Division, that receives patron complaints and suggestions and then forwards them to the proper department for action.

In the Operational Planning Department, we have divided the staff into work teams which are comprised of a service analyst and a schedule maker. These teams are assigned lines and sectors of the service area for which they have complete responsibility to monitor and revise service. Periodically, the teams composition or assignments may change and in some cases two teams might share responsibility on specific projects. The teams are expected to use all available data and to request additional data if necessary to insure that proper transit service is being provided in their assigned areas. This also entails the use of outside information on roadway improvements, construction or development which may affect transit service.

San Antonio, Cont'd.

Mr. Andrew J. Tschlis
M.B.T.A. Advisory Board
120 Boylston Street
Suite #504
Boston, Massachusetts 02116

The concept of breaking the service area down and assigning specific lines and areas as team responsibilities insures that every area is being continually monitored and problems are being addressed as they occur.

If you haven't noticed, we like to pat ourselves on the back when we get the chance, but there is always room for improvement. When our new systems come on-line, we hope, to drastically reduce the time required to detect, define, and correct operational problems.

Please let me know if I might be of further assistance.

Sincerely,

Don Kiolbassa

Don Kiolbassa
Director
Operational Planning Department

DK/bah

Chicago Transit Authority
Merchandise Mart Plaza, P.O. Box 3555
Chicago, Illinois 60654
(312) 664-7200

December 10, 1985

Mr. Andrew J. Tsihlis
Operations Analyst
Massachusetts Bay Transportation Authority
Advisory Board
120 Boylston Street, Suite 504
Boston, MA 02116-4604

Dear Mr. Tsihlis:

Your correspondence to Mr. Hirsch, who is the Manager of the Operations Planning Department, was forwarded to this office as he felt that we could best advise you regarding the duties and responsibilities of supervision, as this office is responsible for the following:

OPERATIONS DIVISION: TRANSPORTATION SERVICE DEPARTMENT

I. PERSONNEL

A. **The Manager:**

1. Responsible for the seven day a week, twenty-four hour a day service operation which serves the city and 39 suburban areas.

2. Monitors and directs activities and personnel using management by objectives.

3. Coordinates the activities of all emergency conditions.

4. Projects service, monetary and equipment needs.

5. Responsible to the Deputy Executive Director, Operations for all vehicles and personnel once they leave their garages or train terminals and ticket agents on duty.

6. Controls 2,275 buses (13,000 daily round trips) and 1,200 rail-cars (2,300 daily departures).

B. Staff:

1. "Area Staff"

Reporting to the Manager are two Directors - Rail and Bus. They are centrally located in the Mart but become mobile as necessary. They oversee CTA's entire operation for their individual sections; make daily inspections; hold weekly meetings advising their personnel of changes or special operations; personally monitor all special events and serious service interferences and work as a unit when necessary.

Mr. Andrew J. Tsihlis Page 2 December 10, 1985

2. "District Staff"

The District staff numbers **36**. They are mobile, on foot and are located in the field. They monitor the following: supervisors and collectors; condition of vehicles; physical condition of streets; provision of adequate service; schedule adherence; administrative duties (payroll, assignments, etc.) and supervisors' duties.

II. BUS OPERATIONS

A. Physical Overview:

Bus operation is served by **five** districts. The districts are geographically divided and are identified as follows: **Far South, Near South, Near North, Far North** and the **Central Business District.** These districts are coded as **A, B, C,** D and **Central**, respectively.

Each district has a superintendent (duties described above). The supervisors in these districts are responsible to them.

B. Staff - 227 Bus Supervisors:

1. Duties

- Observing operations to effectively adjust service. This is accomplished through supervisor observations which number **1,000,000** per year. They report violations of company rules. During the last year, **60,000** violations were reported and referred to the Operations Division Transportation Personnel Department for action. The following are violations found in operation - running ahead of time; leaving the terminal early; ignoring cross line standards; failure to stop at a railroad crossing; improper destination signs, ignoring traffic signals not curbing the vehicles; improper run number displayed; failure to arrive at destination; passing up passengers, improper uniform and smoking on duty.

- Coordinating reroutes, conducting bus checks, making service adjustments, responding to emergencies and restoring service during disruptions. They also conduct special inspections of vault islands and fare boxes.

- Making recommendations for improved scheduled adherence.

2. Roles

All supervisors can perform the three following rules: (Through use of automobile or portable radios, they have contact with the Communication/Power Control Center).

- The radio car supervisors are mobile trouble-shooters. They go to the scene of fires, defective buses and make accident checks. They restore service by filling (turning a bus around or taking a bus from another street), rerouting and adjusting headways.

- The point supervisors help schedule adherence. If necessary, they switch buses in order to meet the street running time. They organize meal reliefs for the operators if special weather or traffic conditions warrant. They "space the street" if schedules cannot be met.

- The **line or route riding supervisors** observe operators' activities. If deficiencies in performance are noted, corrective advice will be given. Customer complaints, such as irregular service, will be given observation checks.

It is further to be noted that each one of our traffic supervisory vehicles, of which there are a total of **45**, contains a tool box. These tools consist of a hammer, screwdriver, pliers and a ratchet wrench. They are used by supervisory personnel in order to maintain service and to perform what we call the **"band-aid approach"** to troubleshooting and bus restoration.

I hope this material and enclosed information will suffice in being beneficial to you and your organization. Feel free to contact this office if you have any further questions. I remain,

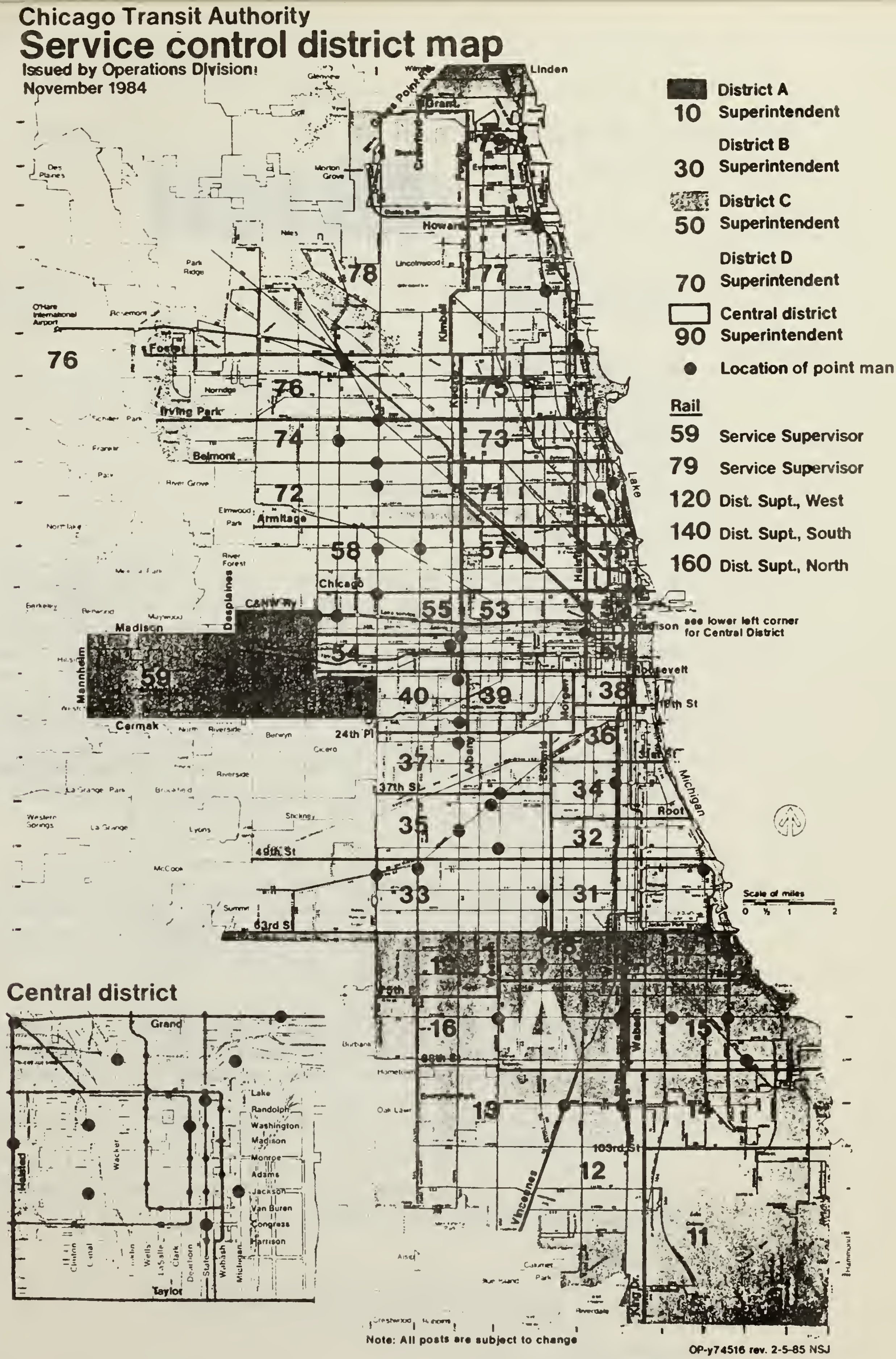
Very truly yours,

Michael V. LaVelle

Michael V. LaVelle
Manager, Transportation Service

ML/rb

Attachments (3)


Chicago Transit Authority
Service control district map
Issued by Operations Division
November 1984
District A
10 Superintendent
District B
30 Superintendent
District C
50 Superintendent
District D
70 Superintendent
Central district
90 Superintendent
Location of point man
Rail
59 Service Supervisor
79 Service Supervisor
120 Dist. Supt., West
140 Dist. Supt., South
160 Dist. Supt., North
see lower left corner for Central District
Scale of miles
0 ½ 1 2
Central district
Grand
Lake
Randolph
Washington
Madison
Monroe
Adams
Jackson
Van Buren
Congress
Harrison
Taylor
Halsted
Clinton
Canal
Wacker
Wells
LaSalle
Clark
Dearborn
State
Wabash
Michigan
Linden
Howard
Foster
Irving Park
Belmont
Armitage
Chicago
Madison
Roosevelt
Cermak
24th Pl
37th St
49th St
63rd St
103rd St
Kimball
Mannheim
Desplaines
Halsted
Ashland
Wabash
Vincennes
King Dr.
Lake
Michigan
O'Hare International Airport
Note: All posts are subject to change
OP-y74516 rev. 2-5-85 NSJ

Norfolk, Virginia

TRT

February 25, 1986

Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street
Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihlis:

As part of Tidewater Transportation District Commission's procedures of monitoring bus schedule adherance and operator's driving habits, we conduct a schedule adherance twice a year and different time points on all line service. TRT doesn't have any automatic vehicle monitoring devices. If an operator is more than 2 minutes early leaving a time point, he or she is considered early.. If an operator is more than 5 minutes behind schedule leaving a time point, then he or she is considered late. These schedule adherences are conducted by transportation surveyors. Data is compiled on all routes. The percentage is compiled for the whole system.

As a back up, in the A.M. and P.M., we have a 4 supervisors assigned to a specific area of the cities monitoring buses. We also have supervisors do spot checks on any problem areas and supervisors assigned to these areas are responsible to correct any problems in his assigned area. In doing this, they also check the operator's driving habits.

Safety personnel also conduct road observations of the operator's driving habits daily. Road observation forms are completed and sent to the Superintendent of Transportation for follow-up action.

I trust the information here-in and the attached sample forms will be of assistance to you.

If I can be of further assistance or if you have any questions, please do not hesitate to contact me.

Sincerely,

TIDEWATER TRANSPORTATION DISTRICT COMMISSION

Gary Lawrence

Gary Lawrence
(Acting Transit Operations Manager)

GLL:pfd
enclosures
xc: G. Richard Hackworth, Transit Operations Manager

Tidewater Regional Transit, P.O. Box 2096, Norfolk, Virginia 23501, Telephone (804) 627-9291

New York City, NY

New York City
Transit
Authority

25 Jamaica Avenue, Brooklyn, New York 11207 Phone (718) 240-

March 13, 1986

Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street
Suite 504
Boston, MA 02116

Dear Mr. Tsihlis:

In response to your request to New York City Transit Authority President David Gunn, I have compiled the following information regarding supervision of Bus Operators.

SCHEDULE ADHERENCE: Several methods are used to monitor Bus Operators for adherence to schedule:

1. Street Supervision - Surface Line Dispatchers are assigned to various routes to regulate the schedule and to make adjustments to off-schedule or off-headway buses.

2. Patrol Supervision - Surface Line Dispatchers and Deputy Superintendents are assigned to radio-equipped vehicles to patrol assigned routes, check for problems causing disruption to service (e.g., fires, traffic, weather, accidents, construction sites, road conditions), and take corrective action.

3. Plain Clothes Observations - Supervision in plain clothes is assigned to ride with specific Operators who have been reported for failing to operate on schedule. These check-rides may result in reinstruction and/or disciplinary action.

4. Electronic Survey - Buses in one depot are equipped with radios that transmit signals picked up by monitors installed along the routes. These signals

are relayed to a central communication center and displayed on a monitored screen. The signals indicate the bus number, run, route, and location. This information, together with programmed data such as the time the run is due at a specific location, enables supervision to take corrective action as necessary.

The tools available to direct the Bus Operator supervision are telephones (public), two-way radios in buses and patrol cars, forms for recording information, and verbal reports from Bus Operators.

OPERATOR DRIVING HABITS: Several methods exist for monitoring the driving habits of the Bus Operators:

1. Street Supervision - Surface Line Dispatchers check the Operators for unsafe driving habits while they are approaching, entering, and leaving bus stops and reinstruct those Operators needing correction.

2. Patrol Supervison - While patrolling assigned routes, supervision is alert for unsafe driving habits of Operators to reinstruct those that need correction.

3. Plain Clothes Observations - Supervision is assigned to observe Bus Operator behavior when passenger complaints indicate that specific operators are driving dangerously. As with schedule adherence observations, these check-rides may result in reinstruction and/or disciplinary action.

The monitoring of Bus Operators for adherence to schedules and for driving habits is only a follow-up to an extensive training program that is followed in New York City Transit Authority. Initial training of new employees, retraining, safety and courtesy classes, and defensive driving courses all emphasize the need for a safe operation, good service to the public, and operating on time.

I hope that this information will be of help to you.

Yours truly,

Lawrence Reuter
Acting Vice President and
Chief Operating Officer,
Surface Transit

Westchester County

ANDREW P. O'ROURKE
County Executive

R. RALEIGH D'ADAMO
Commissioner
Department of Transportation

RAYMOND JURKOWSKI
Deputy Commissioner
Department of Transportation

January 22, 1986

Andrew J. Tsihlis
Operations Analyst
Massachusetts Bay Transportation Auth.
Advisory Board
120 Boylston St., Suite 504
Boston, Mass. 02116-4604

Dear Mr. Tsihlis:

Your letter to our Director of Passenger Services, Clinton Blume has been referred to me for comment. As you may ar may not be aware, Westchester County has a public-private bus operation wherein certain bus services are provided by privately owned bus companies under contract to Westchester County. I prefer to call these "Contracts for Services", as opposed to "Subsidy Contracts".

The privately owned bus companies are conscripted to contract with Westchester County for particular levels of services along with the right to operate over certain routes. Westchester County owns and leases to the bus companies, a majority of the equipment (including buses), while regulating such items as manpower and insurance.

Bus schedule adherence is checked in two ways by this Department. 1) We dispatch checkers and staff to check not only schedule adherence, but ridership also. 2) We have a full system Vehicle Location System (VLS). You are probably familiar with such a system or have heard of it. It operates in the following manner: Signpost transmitters, located at key points (usuallly 5-10 minutes apart) along the bus routes, continuously transmit fixed location information (i.e. the time a bus passes) to a processing unit on each bus which is integrally connected to our basic two-way radio system. The location information is then automatically transmitted to the central processing unit which develops information in both graphic and tabular form which can be displayed on a cathode ray tube (CRT) screen. The VLS also provides data relative to actual schedule adherence and route performance. A hard copy printout is provided of all exceptions (i.e., early or late buses) along with start of runs and trip starts. A side benefit is location during emergencies. Obviously, we have a tremendous data bank.

When the VLS became operational, we did not eliminate all of our road supervision, we did however reduce it by approximately 60%. This has proven to be on target. The reason we did not totally eliminate road supervision was that we still felt that 1) the policemen effect would still be extremely beneficial, 2) it provides infield inspections of things like destination signs, bus conditions and bad driver practices and 3) they are necessasry during emergencies and accidents.

Driver performance and requirements are governed by Article 19-A of the New York State Department of Motor Vehicles which provides for such things as an annual check of a drivers handling of the bus, bi-annual physical examination, etc.

All of our operational management people are called supervisors. Such titles as starters, street supervisors, and inspectors were discontinued almost 15 years ago at which time they were denied union membership and considered a part of the management team. The supervisors are managed by an assistant operations manager who reports to a Superintendent of Transportation/Operations Manager.

I hope this information will be helpful, and I will have copies of some of the forms we use sent to you under separate cover.

Very truly yours,

Perry L. Rogers
Director of Operations

PLR/ghvt

K-21 Rochester, New York

RGR
RTS
REGIONAL TRANSIT SERVICE
P.O. BOX 90629 BEECHWOOD STATION • 1372 E. MAIN STREET
ROCHESTER, N.Y. 14609 • 716-288-6050
an operating subsidiary of the ROCHESTER-GENESEE REGIONAL TRANSPORTATION AUTHORITY

December 18, 1985

Mr. Andrew Tsihlis
Operations Analyst
MTBA Advisory Board
120 Boylston Street
Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihlis,

Regional Transit has 11 road supervisors who monitor schedule adherence, investigate accidents and administer New York State's 19A regulations. Each day one supervisor is assigned to the major timepoint in the CBD to monitor loads, schedules and operational problems such as incorrect destination signs, etc. Two are assigned to our major Park & Ride Terminal in the CBD each afternoon to monitor and coordinate vehicle movements and act as starters. Also, 4 traffic checkers conduct timepoint checks for schedule adherence and passenger loads.

It is the goal of Regional Transit to assure that 90% of all peak-hour trips and 95% of all off-peak services adhere to schedule. Adherence to schedule is defined as being within 0 minutes early and 5 minutes late on any trip. Measurement of schedules are made at random points on the line. No less than one of every three inspections are made at the peripheral terminals of a line.

On nights and weekends RTS has pulse scheduling. Drivers are instructed to call the radio controller if they are going to be late for a lineup so the controller can hold all buses and transfers can be made.

Four supervisors are in car patrols each rush hour, two in the midday period, two on Saturday and one on nights and Sundays. The car patrols look for poor driving habits, operational problems and investigate accidents. To comply with 19A regulations, a supervisor must ride with each driver at least once a year to evaluate driving techniques. RTS also employs an outside agency (as spotters) to assure correct fares are collected, revenue is handled properly, drivers are courteous and are doing what they are paid to do.

At present we are conducting a planning study to determine the feasibility of an automated vehicle monitoring system. Enclosed are examples of forms used. If you have any questions please feel free to call be.

Sincerely,

Charles N. Switzer

Charles N. Switzer
Manager of Schedules &
Analysis

CNS/le
Enclosures

San Diego, California

BUS STOP San Diego Transit
100 Sixteenth Street
P.O. Box 2511
San Diego, CA 92112
(619) 238-0100

December 17, 1985

Mr. Andrew J. Tsihlis
Operations Analyst
Massachusetts Bay Transportation Authority
Advisory Board
120 Boylston St., Suite 504
Boston, MA 02116-4604

Dear Mr. Tsihlis:

San Diego Transit primarily uses Road Supervisors to monitor operator driving habits. "Ghost riders" are occasionally used when complaints are received. A more extensive "Ghost rider" program was discontinued due to funding cutbacks.

On-board checkers are used primarily to count passengers and secondarily to record on-time performance. However, each schedule is checked only once a year, so the usefulness of the on-time performance data is questionable. Road supervisors perform traffic checks if a problem situation arises.

Examples of forms are included. We do not currently use an automatic vehicle monitoring system. However, we are very interested in improving our methodology for determining on-time performance and would appreciate receiving a copy of the results of your survey.

Sincerely,

Janet C. Braaten

Janet C. Braaten
Transit Planner

JCB:mm
Encs.

BC Transit
1200 WEST 73rd AVENUE, VANCOUVER, B.C V6P 6G5 Telephone (604) 264-5000

23 December, 1985

Mr. Andrew J. Tsihlis
Massachusetts Bay Transportation Authority
Suite 504, 120 Boylston Street
Boston, Massachusetts
02116 - 4604

Dear Mr. Tsihlis,

Our Transit Control Department which is in charge of on street supervision consists of:

(a) Manager
(b) Superintendent
(c) 3 Traffic Coordinators
(d) 8 Transit Control Room Supervisors
(e) 54 Transit Supervisors

The Transit Supervisors specific accountabilites are:

1. Monitors the transit service on the road and takes necessary action required to ensure the maintenance of an efficient, regular bus service.

2. Travels bus routes to assist Transit Operators and passengers as required, to identify and report damage to transit property, to observe Transit Operators' driving habits and adherence to B.C. Transit rules and regulations, to perform timing checks and monitor service, to police bus zones, to perform security checks, etc.

3. Lays out and sets up detours as required; prepares information signs and new stops; changes paddles and informs Transit Operators of changes.

4. Responds to incidents that occur, such as assaults on drivers, passenger altercations, vandalism, motor vehicle accidents, breakdowns, etc.; takes action to investigate and resolve problems as required and to return bus service to normal; submits reports concerning incidents that occur.

....2

5. Responds to emergency situations such as fires, downed wires, serious traffic blockages, snow conditions, decides appropriate action and coordinates with affected units and outside agencies such as local police and fire departments.

6. Investigates, as assigned, complaints, commendations, incidents, etc., that are reported; discusses with Transit Operator; submits reports as required.

7. Counsels Transit Operators concerning company policies and procedures such as dress, transfer and day passes, driving habits, etc.; prepares Employee Record Form (ERF), as required.

8. Prepares written reports concerning overloads and scheduling problems, unsafe conditions, motor vehicle accidents, daily occurences, etc., on an ongoing basis.

The Transit Supervisors report to the Traffic Coordinators. Traffic Coordinators general accountability:

Reporting to the Superintendent - Traffic, the Traffic Coordinator ensures the consistency and efficiency of Transit Supervisor's engaged in on-the-street monitoring of bus operations. Responds to trouble calls i.e. down-wires, serious accidents and directs operations as required. Provides on the job instruction for Transit Supervisors. Maintains liaison with Police and Fire Departments in coordinating action during emergencies or special events. Maintains contact with operations and planning sections regarding service changes, ensures changes transmitted to Supervisors.

Traffic Coordinators specific accountabilities:

1. Ensures the consistency and efficiency of on-the-road transit service by supervising Transit Supervisors engaged in monitoring and checking the service; ensures the proper conduct and consistent approach in the performance of their duties.

2. Ensures efficiency of Transit Supervisors by providing on the job instruction, overseeing their performance, allocating assignments and scheduling shifts.

....3

3. Ensures safety of operations and use of correct safety procedures by attending trouble calls such as serious accidents, down-wires etc.; takes statements from operators involved in accidents/incidents as required.

4. Participates in training programs for Transit Supervisors by arranging dates with B.C. Hydro and attending courses to observe their progress.

5. Liaises with Transit Control, exchanging information on accidents, breakdowns, power-outages, to ensure the least disruption of service; receives information on service changes and ensures transmitted to Transit Supervisors.

6. Prepares a variety of administrative reports such as accident reports, attendance sheets, employee record forms, ensures accurate and complete and appropriate action taken.

7. Maintains liaison with City Officials, Police and Fire Departments and ensures coordination and appropriate action taken such as units assigned, bulletins circulated re: routes, procedures, sufficient Supervisors during emergencies, parades, special events.

Monitoring Schedule Adherence

The on street Transit Supervisors work in mobile units and corner location point duty. The mobile units are expected to be in their assigned area. They are accountable to monitor the transit service and take the necessary action to maintain this service.

We have six (6) corner locations in the City of Vancouver. They are assigned at intersections that allow the Supervisors to observe approximately 90% of the transit lines operating within the City.

The Supervisors working point duty have the same accountabilities as mobile Supervisors but their main function is to watch for schedule adherence.

....4

The Supervisors have a work sign-up approximately every 4 months. At this time they can sign either a mobile unit or corner location.

I have attached a computerized corner book for your information. These books are supplied at each sheet change to the corner locations. The mobile units receive numerous books for different locations in their assigned area.

Operator Driving Habits

Our training section ride checks every operator on a two year cycle. If they are involved in an accident and/or receive complaints in regards to their driving habits, their operations supervisor may request a special ride check to correct their procedure. A Transit Supervisor may also request a ride check to find out why an operator is having schedule adherence problems etc.

Attached is a copy of the form used for ride checks by our Training Department.

Employee Record Form

Attached is a copy of an Employee Record Form. This form is used by Transit Supervisors to document operators for infractions such as operating ahead of schedule etc. The Transit Supervisors rarely submit this form for the first infraction. We ask that they talk to the operators first and if the offence is repeated to submit the form to the operators operations supervisor. The operation supervisor will then call the operator into his office and document the infraction on the operators file. The operator is then into our Counsel and Control Plan. If no more infractions are repeated within 12 months then his record will be considered clean.

I would like to advise that at this time we do not have an automatic vehicle monitoring system.

I have attached every form used by Transit Supervisors and I hope it will be of some assistance to you.

If there is any other information that you require please do not hesitate to contact me.

Yours truly,

B. Beattie
Director
Lower Mainland
Bus Operations

BB/gm

Toronto, Ontario

TORONTO TRANSIT COMMISSION

1900 YONGE STREET, TORONTO, CANADA, M4S 1Z2
TELEPHONE (416) 481-4252, TELEX 06524670

December 30, 1985

Mr. A.J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street, Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihlis:

Your letter of December 4, 1985, to Dr. J. Pill concerning field supervision of bus operations, was referred to myself for reply. In this regard, we offer the following.

By way of background, our operating area, Metropolitan Toronto, encompasses 244 square miles. We were budgeted to carry approximately 432,000,000 passengers in 1985 on 141 routes, 132 of which connect with 66 rapid transit stations. This service is provided from 10 separate operating locations.

Field supervision for this service is provided through the following means:

- o Transit Control - coordinates all emergency action and arranges for change-off vehicles.
- o Mobile Supervisors - in radio equipped vehicles.
- o Route Inspectors - on foot, equipped with two-way radio's.
- o Communications Information System (C.I.S.) - computerized vehicle monitoring system.

How we utilize each of these methods is summarized below as is the use of "starters".

Transit Control

A centrally located facility, provides 24 hour/day, 7 day/ week system supervision. It has facilities to visually monitor and communicate directly with subway trains and SRT vehicles (Rapid Transit). Communications with surface routes are maintained through the phone exchange (Bell) or via a portable radio link to all field supervisory personnel. Transit Control is responsible for the initiation and coordination of all emergency activities. Its duties, in this role, include maintaining liaison with Police, Fire, and Ambulance services through direct "hot lines".

Mobile Supervisors

A staff of 20 Mobile Supervisors, who are assigned to Transit Control, provide supervision 24 hours/day, 7 days/ week, in 4 downtown districts, and if required, 9 surrounding districts. They are responsible for:

- Monitoring route Inspectors.
- Accident investigations.
- Monitoring regular or special services.
- Attending major delays/emergencies and implementing diversions.
- Periodic loading and schedule adherence checks.
- Metropass checks.

Route Inspectors

A staff of 220 Inspectors distributed between the 10 operating divisions provide supervision 16-20 hours/ day, 7 days/week. Inspectors are expected to "roam" either side of a designated point on a route. All Inspectors are equipped with two-way radios for communication with Transit Control. In summary, Inspectors are responsible for:

- Ensuring regular or special service are operated according to schedule on specific routes.
- Checking operating personnel with respect to Commission policy.
- Accident investigation.
- Assisting the Police/Fire Department/Ambulance, etc.

- Preparing service reports.
- Providing loading and schedule adherence checks.
- Metropass checks.

<u>Communications Information System (C.I.S.)</u>

C.I.S., an experimental system, is presently restricted to one operating division, with 272 buses. It permits the visual tracking of buses from a central location. The system allows for direct communication by either voice, text messages, or special alarm features and is also capable of providing a number of management reports, e.g. schedule adherence, running times analysis, etc.

<u>Starter - Despatcher</u>

I have interpreted your term "starter" to be an individual who is responsible for despatching vehicles. In this regard, despatchers are located at each of the 10 operating divisions and report to the Equipment (Maintenance) Department. Despatchers are responsible for assigning vehicles to runs.

To further assist you, I have enclosed Chapter 15 "Service Control" from a recently released Canadian Urban Transit Association Handbook".

In closing, should you require any additional information, please feel free to contact me.

Yours very truly,

N. LASH
Manager of Transportation

6-108-52
Enclosure

TORONTO TRANSIT COMMISSION COMMUNICATIONS AND INFORMATION SYSTEM (C.I.S.)

The Communications and Information System project concept and its design specifications are the result of a study approved by the Toronto Transit Commission in 1973 and carried out by a special study team of TTC staff, consultants and representatives of the Ontario Ministry of Transportation and Communications and the Municipality of Metropolitan Toronto during 1973 and 1974.

C.I.S. is a joint project of the TTC and the Province of Ontario. Provincial participation and funding is part of the government's program to assist public transit.

BACKGROUND

Following an analysis of existing TTC methods of communications and control and a selective study of several TTC surface routes, the study team made world-wide inspection trips to cities which are involved in the development and use of various types of automatic vehicle communication systems. After evaluating all aspects of each system, the study team concluded that if the TTC is to maintain and improve transit service in the future and effectively anticipate and respond to the increasing demands being placed on its services, the existing communications and information system should be improved to more effectively carry out the following control strategies:

Route Supervision — early detection of variations from schedules and effective implementation of corrective action to lessen the bunching and overloading of vehicles as well as more reliable and consistant schedule adherence;

Emergency Handling — immediate notification of emergencies, ready dispatch of assistance and effective restoration of service;

Dynamic Scheduling — collecting and processing of continuous data on passenger movements on each surface vehicle for faster and more responsive scheduling as well as more effective allocation of vehicles and manpower;

Management Reporting — automatic recording of events and preparation of management reports;

Passenger Information — processing of real-time service information for the benefits of passengers who phone in who are waiting at major bus stops as well as provision of more effective ticketing and marketing information;

Traffic Signal Priority — transmission of transit vehicle locations, running times and passenger loadings to provide both on-line and off-line interfaces with the Metropolitan Toronto Traffic Signal Computer Control System, allowing the eventual provision of signal priority for transit vehicles.

DEVELOPMENT

The study team reviewed in detail the types and costs of equipment available for the recommended system and concluded that if the features of the planned TTC system were to be achieved in the most cost-effective manner, improvements were required in available hardware and technology. Based on the consultants' recommendations, it was decided to use the most advanced computing and communications elements for the on-vehicle and control station installations. This approach resulted in the combination of all on-vehicle data handling and logic functions into a single and compact unit called TRUMP — TRANSIT UNIVERSAL MICRO-PROCESSOR.

Development of the TRUMP concept and related computer, electronic and radio components was carried out during 1974 and 1975 by TTC staff and its consultants. The system, which included automatic tracking/vehicle location, two-way data and voice radio communications and driver keyboard/display units allowing transmission of pre-coded messages, was successfully demonstrated on a test route. Work was also carried out on the development of on-board, automatic passenger counters which record the number of boarding and alighting passengers.

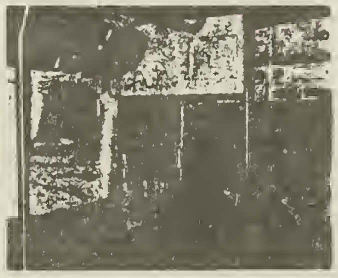
Based on the success of these tests, approval was given by the Commission for a pilot project based at TTC's Wilson Division. This phase of the project involved the establishment of a C.I.S. Control Centre at Wilson and equipping 100 surface vehicles for operation on six routes; Dufferin, Sheppard West, Finch West, Wilson Heights, Faywood and Senlac. C.I.S. equipment was also installed in one supervisory cab. The pilot project was completed in the early part of 1980.

In order to gain additional experience in the operation of this system, it was decided to equip all Wilson Division routes — over 260 vehicles (Phase VI). This system became operational in the fall of 1984. Work is now being carried out to determine how the balance of the Commission's surface fleet should be equipped with C.I.S.

MARK I — TRUMP

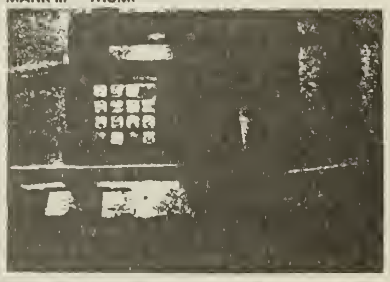
The very first prototype of vehicle equipment for the C.I.S. Project was handbuilt and very large. This was necessary to facilitate testing and debugging. The large open box contained the microcomputer (TRUMP), power supplies, test switches and cable terminations. The two-way UHF radio is seen at the top left corner. Also included was an 8-light display unit (on the dash), a 16-button keyboard unit (in front of the Operator's knee) and a hand-held microphone.

MARK II — TRUMP



The vehicle equipment used for the ten-vehicle test was much more compact. The radio, power supply, TRUMP and cable terminations were all mounted above and behind the Operator's area. This section was closed in with a moulded cover to blend in with the decor of the vehicle. The 16-button keyboard and console is shown to the right of the Operator's area. This particular installation tested a handset (similar to that on a telephone) instead of a hand microphone and speaker.

MARK III — TRUMP



The vehicle equipment used for Phase V (the 100 bus test) was greatly reduced in size. This one package contains the microcomputer (TRUMP), the two-way radio, power supplies, a 32-character alpha/numeric display, the driver's keyboard and a telephone type handset. This compact approach greatly reduced the cost of packaging and installation. Also included on the vehicle are a boom microphone (for hands free operation), internal and external P.A. systems, a passenger counter at each stairwell, an odometer sensor for continual location information and a signpost receiver for exact "location fixes". Phase VI TRUMPS, although functionally identical, are slightly smaller.

This Test Bus was the TTC's mobile laboratory for developing reliable and economical components for the Communications and Information System. A micro-computer on board connects passenger counters, driver console and location device to a radio system to provide continuous information of vehicle location and status to the control centre and to provide the driver with special messages. Two-way voice radio communication between the control centre and the bus driver is provided. However, well over 90% of all radio transmission is digital.

A typically congested Toronto street, one of the reasons for C.I.S.

Salt Lake City, Utah

UTAH TRANSIT AUTHORITY
3600 South 700 West
P.O. Box 31810
Salt Lake City, Utah 84131
Telephone (801) 262-5626

UTA

December 19, 1985

Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street, Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihilis:

The Utah Transit Authority employs some thirty "Operations Supervisors" whose duties are split into three primary functions, (i.e., Division Dispatcher, Radio Controller, and Road Supervisor). Schedule adherence and operator driving habits are monitored in the field by road supervisors.

Radio technicians at UTA have developed a low cost vehicle monitoring unit which utilizies existing radio hardware. This system, which we call "Portable Vehicle Monitoring (PVM), is explained in the enclosed report which I wrote a year ago. This system is still developmental in that data manipulation software has not been produced. We have used this system to examine a number of routes in terms of real-time performance. The data for one of our Salt Lake City routes is included in the report.

I have also enclosed several forms which we use in behavior modification with our operators. Our progressive discipline policies are based upon timely and proper documentation via these forms.

If you have any questions, please feel free to call.

Sincerely,

Craig Porter

Craig Porter
Operations Manager
Central Division

enclosures

CP:cf

INTRODUCTION

The Utah Transit Authority has a strong commitment to on-time schedule reliability. From that commitment has come a recognized need for accurate, low cost system monitoring which would allow for positive problem identification and resolution. UTA communications technicians, recognizing that need, have developed a prototype automatic vehicle monitoring (AVM) system which will soon be tested in service at UTA.

Clearly, the most obvious need for such a system comes from the desire to obtain reliable schedule integrity measurements. The Operations Department currently collects reliability data, but as will be discussed further in this report the collection techniques are inadequate for a number of reasons.

Aside from its potential application as a measuring tool, AVM will provide a strong new dimension in the areas of operator supervision and route scheduling. Both of these facets will be discussed, and the proposed UTA AVM system will be outlined in this report.

TECHNICAL OVERVIEW

The AVM hardware developed at UTA is a low cost alternative to the large monitoring equipment in use at several transit properties throughout the United States and Canada. The system was designed to interface with the existing communications equipment at UTA.

The basic component of the monitoring hardware is a portable, low power transmitter which would be placed at designated locations within the transit system. The transmitter is unique in that it sends out a digital code which is useable only by a companion receiver installed on transit vehicles. As a vehicle passes within 300 feet of a "signpost a signal is triggered and a message is relayed from the bus radio equipment to the primary computer at the UTA Central Division. This message is received via a separate message channel and the information is logged. At the present stage of development only the bus number and time of day are included in the message. Format output is currently being designed which will provide further information in both graphic and numeric form. Examples of several proposed outputs are included in the Software Development section of this report.

METRO

Kansas City Area Transportation Authority
1350 East 17th Street, Kansas City, Missouri 64108
(816) 346-0200

January 9, 1986

Mr. Andrew J. Tsihlis
Operations Analyst
MBTA Advisory Board
120 Boylston Street, Suite 504
Boston, Massachusetts 02116

Dear Mr. Tsihlis:

This letter is in response to your letter concerning field supervision of our bus operation.

Our field supervision is monitored by a staff of nine road supervisors and a Manager of Road Supervision. For the purposes of supervision, our system is divided into districts. Each district is under a team of supervisors who work regular eight-hour shifts, either A.M. or P.M. We maintain our street supervision by at least one supervisor from 4:00 a.m. until 1:00 a.m. the following morning. This time period covers generally the first bus out until the last one is in.

All district supervisors use autos to patrol their areas, and each auto is equipped with a two-way radio for direct communication with the radio dispatcher. Each radio is equipped with a scanner so that all radio communication between operators and dispatcher can also be monitored. All our rolling equipment, buses, service trucks, tow trucks, etc., are radio-equipped. Supervisors can communicate with any operator over the radio by being patched through the radio dispatcher.

In addition to the car radio, each district is assigned a portable radio with earpiece attachment. This gives the supervisor quite a lot of flexibility in moving around when out of the car.

Following is a description of some of the duties of the district supervisor:

Duties

Each supervisor is responsible for all our street operations within their assigned area. They conduct regular schedule adherence checks, investigate and complete accident reports, reroute buses when necessary, observe operators for driving habits, and, in general, strive to maintain an adequate level of service throughout the system. Aside from these duties, they also carry out any special assignments which they are assigned.

Schedule Adherence Checks

A primary responsibility of each supervisor is to constantly make schedule adherence checks on all routes throughout the system. Our checks are conducted in the following manner:

Mr. Andrew J. Tsihlis
January 9, 1986
Page 2

Each operator is given a schedule for their assigned run, and listed on this schedule are time points at various intersections along the route. A supervisor can be stationed at any of these points and check arrival times of each bus on the route. Normally, checks are conducted at these points for about 30 minutes. Early arrivals in excess of one minute are charged with a schedule violation, and a written report is forwarded to me for disposition according to our "Operator's Manual of Instruction."

Forms

I have enclosed a number of forms which are used by district supervisors to report various activities which occur on the road. I have completed a copy of some of them as a sample of what information is required.

Also included are several operator's "Block Schedules" with various time points underlined in red, as well as an "Operator's Manual of Instruction."

I hope this information will be of service to you and will give a general idea of our field supervision. If I can be of further assistance to you, please let me know.

Sincerely,

Nick Green

Nick Green
Manager of Road Supervision

NG:meb

Enclosures

APPENDIX L

From Recertification Program Mid-Point Evaluation, MBTA, April 8, 1985

IV. Beyond Recertification

Many officials are asking what lies beyond the June closing of this year's recertification endeavor. Will future training consist only of recertification in the areas of CPR and Control/Restraint Techniques? Speculation as to the direction of continuing education and training for the first-line supervisor at this point would be just that -- speculation. It can be said, however, that this human resource development mission is far from over. A significant reinforcement link is apparently missing which is thwarting the efficacy of training received by Chief Inspectors/Inspectors, and it would seem that unless corrective action steps are taken to ensure that acquired skills are maintained and reinforced beyond classroom parameters, performance could regress to a perfunctory level, making further training limited to a review of previously learned skills with little or no focus on development.

Transportation is aware of the many Chief Inspectors/Inspectors who feel unable to effect change within their respective areas. Middle-level supervisory personnel for the most part hold the misnomer "police school" when referring to both Chief Inspectors/Inspectors training programs and may be unwittingly causing the atrophy of acquired skills and professional behavior. Many Chief Inspectors hold the misconception of upper management as Machiavellian characters plotting in smoke-filled rooms, table-pounding agggressively, pushing for rigid adherence to dubious policies and procedures which they, the first-line supervisors, are expected to implement without benefit of input.

Lack of confidence on the part of area level managers in first-line supervisors as competent officials is still a prevalent feeling among the vast majority of Inspectors. The unwillingness on the part of local Supervisors/Station Masters to delegate authority is often cited. The lack of feedback on positive performance continue to emerge as another area yet to be improved and perhaps contributes to the problems associated with the lack of reinforcement in maintaining learned skills, according to Inspectors. The cited inadequacy in two-way communication often leaves the first-line supervisors standing in a quagmire of one-way directives, insulating them to the cold reality that energy, in the form of ideas, creativity and innovation emanates only from the inner circle of middle management.

If the full impact of training is to be realized on the local levels, areas must begin to realize that top performance and professional behavior and attitude are directly related to constructive feedback upon application of learned skills.

Inherent in these apparent shortcomings lie the potential resolutions. Transportation has been well aware of the frustration threshold of its first-line officials and has begun to spearhead these issues. What first appears as obstacles to growth and further development, when perceived progressively, serve more as stepping stones to prospective growth. From this evaluation pragmatic resolutions which will lead to the reinforcement, maintenance and continuation of learning experiences can be scanned.

Transportation has already lead an expedition through its managerial strata and has perhaps discovered the panecean solution: investing resources in the education and development of its local managerial stratum. By expanding the training mission to include the development of local area Assistant/District Station Masters, Station Masters, Train Starters, Supervisors and Suburban Managers, Transportation first-line officials would not only be more effectively utilized, but their continuing growth needs could be addressed and met more fully within their respective areas of assignment. The areas of training and education which many area managers feel would benefit them personally and professionally, as well as aid in the further development of first-line officials, would include courses/seminars in:

Team Building (quality circles)
Situational Managment
Creative Problem Solving
Interviewing Techniques
Cross-Cultural Management
Strategic Planning
Performance Appraisals
Reward Systems Development
Budgeting
Time Management
Stresss Management and
Communications.

APPENDIX M

BLUE BEACONS FOR INSPECTOR VANS

(1)

To: Paul J. Lennon Chief Transportation Officer	MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
From: Albert E. Good Assistant General Counsel	Date: October 11, 1984

Re: Permits For Blue Lights and Sirens

Attached please find a photocopy of Rules and Regulations regarding "Mounting and Display of Amber Light(s)", as well as an application for a permit to mount and display a blue light.

I spoke with Robert J. Kelly of the Registry of Motor Vehicles about the request to mount blue lights on transportation supervisory vehicles, and it was his opinion that they should not be issued, but that he would not make a definite judgment until we filed a permit application. He stated that reference to a "railroad police department" in Section 7E of Chapter 90 of the Massachusetts General Laws was put in for the Boston and Maine Railroad.

I would suggest that the permit be filled out and filed in accordance with the regulations and that we then await a definitive ruling by the Registry of Motor Vehicles.

Albert E. Good

Albert E. Good
Assistant General Counsel

AEG/J

Attachment

TRS-119

The Commonwealth of Massachusetts
Registry of Motor Vehicles
100 Nashua Street, Boston 02114

ALAN MACKEY
REGISTRAR

Dear Chief:

In accordance with the provisions of Chapter 263, Acts of 1983, effective March 20, 1984, all applications for permits to mount and display Blue Lights must be made to the Registrar by the head of the Police Department.

Accordingly, the Registry of Motor Vehicles will provide permits, as required, to all Police Departments, to be completed in triplicate. Please type or print legibly.

The first (1st) copy is for the applicant, second (2nd) copy is the Registry of Motor Vehicles' file copy and the third (3rd) copy is to be retained by the head of the issuing Police Department. Upon completion, forward the 1st and 2nd copies to the Registry of Motor Vehicles, Vehicle Inspection Section, 100 Nashua Street, Boston, Massachusetts 02114. The applicant's (1st) copy will then be validated with the Registrar's signature and returned to the Police Department, for issuance to the applicant. The Registry (2nd) copy will remain on file at the Vehicle Inspection Section of the Registry of Motor Vehicles.

Please note that there are provisions on the back side of the permit for change of motor vehicles, which must be approved by the head of the Police Department. In order to keep our records current, please notify the Vehicle Inspection Section (at above address) of any approved vehicle changes. Any change of registration number will necessitate a new permit. Permits are valid until surrendered or revoked.

Very truly yours,

Peter Kopanon

Peter M. Kopanon
Program Director
Vehicle Inspection
Section

PMK/def

APPENDIX N

DESCRIPTION OF THE TRAFFIC DEPARTMENT AT GCRTA (CLEVELAND)

TRAFFIC DEPARTMENT

The Traffic Department is comprised of:

1 Superintendent of Traffic, Grade G
3 Traffic Supervisors, Grade D
10 Radio Control Supervisors, Grade C
24 Zone Supervisors, Grade 6
10 Supervisors of Bus Operations, Grade 5 (Traffic Inspectors)

It is our responsibility to provide quality transportation service through the on-road supervision of 800 plus buses while in service throughout Cuyahoga County, as well as portions of Lake, Medina and Lorain Counties.

The Superintendent of Traffic:

1. Heads the supervisory staff and assumes total responsibility for maintenance of service by the staff.

2. Maintains an up-to-date knowledge of current and temporary bus stops and provides the traffic input for locations of bus shelters installed for RTA.

The 3 Traffic Supervisors:

1. Provide assistance to the Bus, Zone or Radio Control Supervisors during their tour of duty.

2. Assist the District Dispatchers during night or weekend shifts when other administrative personnel are off duty.

3. Assure that the weekly work assignments provide adequate supervision at all times.

Traffic Control Center

The Traffic Control Center, located on the 10th floor of the State Office Building, is manned 24 hours a day, 7 days a week, by the Radio Control Supervisory staff.

Each Radio Control Supervisor is responsible for the radio calls received on his console channel. The 8 channels covering the GCRTA area are:

#1 Woodhill
#2 Hayden
#3 Brooklyn
#4 Triskett
#5 Rapid Transit
#6 Paratransit
#7 Supervisors
#8 Transit Police

One channel is planned to be used as a Data Channel which will set, in priority, all in-coming calls. The implementation, which began August 4, 1980, with the first training session, will alert the Radio Control Supervisors of any EMERGENCY calls from the operators.

Four Radio Control Supervisors are responsible for all incoming radio and telephone calls during the peak operating times and 1 or 2 Radio Control Supervisors during the off-peak hours and weekends.

The Radio Control Supervisors:

1. Must be prepared to answer each question the operator or supervisor on his channel may ask.

2. Determine immediate bus reroutes in cases of fires, accidents, or other hazardous conditions with a minimum of missed bus stops.

All supervisory personnel work together to assist passengers so as to limit the time delays and avoid other areas of possible passenger discomfort. This is particularly the case during adverse weather conditions.

In addition, the Radio Control Supervisors monitor the other departments, using the frequency to dispatch assistance or other emergency vehicles to the troubled area. During emergency situations all road activities are dependent on Radio Control Supervisors to coordinate operations until the situation returns to normal. Their objective is always to improve the plight of the passenger.

Our traffic supervision assures that service is maintained in the GCRTA area of operation which is subdivided into 8 zones. Each zone is supervised by a Zone Supervisor using a van. In order for the Zone Supervisors to discharge their duties, each van is equipped with the tools of the trade — salt for winter, cables for tired batteries, watering cans for overheated engines, etc.

Zone Supervisors:

1. Answer the trouble calls when a message is received from the Traffic Control Center.

2. Assist at various locations along service routes.

3. Provide support to the Supervisors of Bus Operations who are positioned at carefully chosen locations along the service routes.

4. Investigate accidents when buses are involved and make detailed reports and pictures.

The Supervisors of Bus Operations (Traffic Inspectors):

1. Check on each bus when it arrives at the designated check points to verify that service scheduling and other operating procedures are being adhered to by the operators.

2. Provide location assistance to the operator and the passenger.

3. Must be prepared to answer any questions or problems, including assisting in minor bus repairs, such as adjusting mirrors or doors.

4. Maintain contact with the Traffic Control Center by a hand held two-way radio and telephone.

In addition, the Traffic Department provides assistance to the Light and Heavy Rail systems, as requested, and to the affiliate systems of Maple Heights, North Olmsted and Brecksville, when needed.

So, as you can see, although the department is small in size, its influence is felt in every aspect of operations, assuring the passengers of safe, reliable and continuous service.

TRAFFIC CONTROL CENTER

This center is the heart of the GCRTA Communications System. From here a Traffic Supervisor can communicate with any radio equipped vehicle or person in the system. The console equipment was supplied by MOTOROLA as part of a contract that expanded the GCRTA radio system from 4 radio channels to 9 radio channels.

The system currently has:

4 channels for Bus Operations
1 channel for Rail Operations
1 channel for Paratransit
1 channel for supervisors, maintenance personnel and executives
1 channel for Transit Police
1 channel normally used for the exchange of data with the automated on-board radio equipment

Console Capabilities

Each console is identical and has the capability to control any one or all of the radio channels. Any Traffic Supervisor can also patch a message from any voice channel to any other voice channel, or to any of the telephone lines coming into the center. Each Traffic Supervisor can record, at his console, any inbound radio messages as well as pre-record a cassette tape and play the pre-recorded message out on any of the radio channels. All voice messages are automatically recorded on the Dictaphone multi channel recorder.

Fleet Management System

The Cathod Ray Tube in the center of the console is the display part of the computerized fleet management system that automatically routes to the appropriate Traffic Supervisor any request to talk, mechanical malfunction, or emergency alarm from the vehicles that are equipped with the automated on-board radio equipment.

The fleet management system uses MOTOROLA TDS2500 software and MOTOROLA Metro II Mobile Data units. This system allows an operator to prioritize his/her request to talk by utilizing one of the "Code" buttons on the face of the control panel or by using the "Request" or "Priority" button. When one of the buttons is depressed by an operator, the line/block number, vehicle number, code button, and assigned channel number of the vehicle is automatically routed to the Traffic Supervisor responsible for that channel and placed in "Queue" according to the priority of the button pushed by the operator.

The Traffic Supervisor then simply works from the top of the list knowing that he is always responding to the vehicle with the highest priority message. He can call the vehicle on the top of the list by simply pressing one button. The Traffic Supervisor can additionally call a vehicle by its assigned line/block number, or its vehicle number if the line/block number is unknown. He can also call all the vehicles on a line if he has a message pertinent to a particular line or he can call all of the equipped vehicles in the fleet if he has a message pertinent to all of the vehicles.

The vehicles are equipped to respond to any of up to 6 vehicle mechanical alarm sensors or other types of electrical closures such as utilized for farebox tampering.

Emergency alarms are accompanied by an audible alert and flashing indication on the screen to draw the immediate attention of the Traffic Supervisor to the emergency.

The computerized system is designed to be easily expandable to other automatic vehicle monitoring functions such as passenger counting and vehicle location.

The consoles are wire line connected via the telephone company to the 10 base stations at a single tower belonging to television station WJKW located approximately 10 miles south of the downtown area. The radio system covers the entire service area of GCRTA from this site.

The computer system also provides hard copy logging of all inbound data messages originating from the Metrocom II equipped vehicles (800 GCRTA vehicles are equipped presently) and all outbound commands by the Traffic Supervisors.

The computer controlling the system is a Digital Equipment Corporation (DEC) PDP 1134 with two RL01 disk drives.

The system has a "Fallback" mode in which a Traffic Supervisor can still call a vehicle by voice even if the computer is off line because of failure or preventive maintenance. Hard copy printing of emergency alarms are also provided in the Fallback mode.

Supervisor vehicles and key personnel are equipped with recall decoders or pocket paging receivers that can be actuated by any of the Traffic Supervisors with the two tone sequential encoder.

All reports may be generated immediately, or scheduled automatically. If automatic, they will reflect the data accumulated over a period not to exceed 24 hours. The following management information type reports available from the system are:

MOBILE ACTIVITY REPORT

This report will be sorted by a garage and will show the vehicle number, the number of request to talk, the emergency alarms, and the number of mechanical alarms for each vehicle that had any of the above activities during the reporting period.

CHANNEL ACTIVITY REPORT

This report will show for each radio channel the number of-vehicle initiated events, the number of dispatcher initiated commands, and a total for the number of events occurring during the reporting period.

ALARM ACTIVITY REPORT

This report will show for each vehicle that sent an alarm, the number of alarms, the type of alarm, the time the alarm occurred, and the vehicles assigned number (route/run) when the alarm occurred.

DISPATCHER ACTIVITY REPORT

This report will show for each dispatcher the number of selective calls made to vehicles, the number of group calls, group announcements, calls to vehicles in the fleet, announcements to all vehicles in the fleet, transmitter enables, transmitter disables, alarm tests, and a total of all activities.

MOBILE MALFUNCTION REPORT

This report provides a listing of every vehicle that has failed a specified number of communications within a specified time frame.

APPENDIX O

ADVISORY BOARD-PRODUCED DRIVER PADDLE USING CURRENTLY AVAILABLE DATA

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
SURFACE OPERATOR TIME CHECK SHEET

BENNETT STREET RATING STATION (@ CHARLESTOWN GARAGE)

RUN :1096
REPORT TIME : 1607
PULLOUT TIME: 1617

ROUTE	LEAVE	DUE	DUE	DUE	DUE
8801	CLAR HILL	DAVIS STA	LECHMERE		
	1632	1636	1651		
8802	LECHMERE	DAVIS STA	CLAR HILL		
	1701	1718	1722		
8801	CLAR HILL	DAVIS STA	LECHMERE		
	1732	1736	1751		
8802	LECHMERE	DAVIS STA	CLAR HILL		
	1800	1817	1821		
1	PULLBACK TO CHARLESTOWN GARAGE				
	1634				
2	PULLOUT FROM CHARLESTOWN GARAGE				
	2004				
7702	BENNETT ST	PORTER SQ	NORTH CAMB	ARL CTR	ARL HTS
	2032	2038	2042	2049	2057
7701	ARL HTS	ARL CTR	NORTH CAMB	PORTER SQ	BENNETT ST
	2105	2112	2120	2123	2127
7702	BENNETT ST	PORTER SQ	NORTH CAMB	ARL CTR	ARL HTS
	2130	2136	2140	2147	2155
7701	ARL HTS	ARL CTR	NORTH CAMB	PORTER SQ	BENNETT ST
	2200	2207	2215	2218	2222
7702	BENNETT ST	PORTER SQ	NORTH CAMB	ARL CTR	ARL HTS
	2224	2230	2234	2241	2249
7701	ARL HTS	ARL CTR	NORTH CAMB	PORTER SQ	BENNETT ST
	2300	2307	2315	2318	2322
7702	BENNETT ST	PORTER SQ	NORTH CAMB	ARL CTR	ARL HTS
	2324	2330	2334	2341	2349
7701	ARL HTS	ARL CTR	NORTH CAMB	PORTER SQ	BENNETT ST
	2400	2407	2415	2418	2422
7702	BENNETT ST	PORTER SQ	NORTH CAMB	ARL CTR	ARL HTS
	2430	2436	2440	2447	2455
1	PULLBACK TO CHARLESTOWN GARAGE				
	120				

DRIVER PADDLES-FROM DRIVER TRAINING MANUAL, GREATER CLEVELAND REGIONAL TRANSIT AUTHORITY

Focus 7-3: Paddles

Operator must be able to read a paddle and be sure that the paddle is on the bus and remain there until the last operator brings it into the garage

A paddle is a compete work description of a block from the time a bus pulls out until it pulls in.

It contains the following information:

A. Destination - Where you are going (end of the line)

B. Departure Time - Scheduled leaving time at the start of a trip. (Leaving from the end of the line).

C. Arrival Time - Scheduled time to arrive at destination (end of the line).

D. Relief Time and Location - (Scheduled time and location relief is to be made).

E. Block Number - A series of identifying numbers without duplication assigned to each line out of a district.

F. Lines - The routes for which information is given. (Example #78 W. 98th Puritas).

G. Time Points - Arrival times at various points along the line.

H. Symbols - Sometimes symbols are located on schedules with explanations listed at the bottom of the paddle.

I. Run Number - A run is a days work.

Information that is on a Paddle:

a. Pull on and Pull off Routes.

b. Comfort stations. (Locations)

c. Special fare collection procedures.

d. Map of Route being worked.

e. Other special information.

When reporting to the garage for your pull-out, you will procure the paddle for your run from the dispatcher. This paddle is a complete work description of a block from the time the bus pulls-out until the time it pulls-in. The paddle is to remain on the bus from pull-out to pull-in even though a relief is made.

It is the reponsibility of the operator who pulls the bus into the district in the evening to see that the paddle is turned in to the district dispatcher.

REMEMBER, EVERY OPERATOR IS RESPONSIBLE FOR SEEING THAT THE PADDLE IS ON THE BUS WHEN HE GETS ON. If the paddle is not on the bus when you relieve, call Traffic for instructions. You can't place the balme for failure to do this on "the other guy or gal". Moreover, THE PADDLE MUST REMAIN ON THE BUS UNTIL THE LAST OPERATOR BRINGS IT INTO THE GARAGE.

Note: If an Operator loses a paddle, he will be charged $5.00.

How a Paddle is read. - Refer to Page 7- 20

1. Run number.
2. Block number - first two digits represents the route.
3. Station Report and Pull-Out time.
4. Time Points - locations on the line where the bus is scheduled to arrive at a specific time.
5. The location where you cut into line after pulling out of garage (the starting point of your first trip).
6. Destination (the last time point in each column) and arrival time at the end of the line.
7. Scheduled leaving time from the end of the line.

   Note: The time between (6) and (7) is layover time, (Layover time is also recovery time.)

8. Symbols - deviations in the route and/or connections.
9. Relief - (110) designates that the operator is to be relieved by Run 7852 at 1:10 p.m. at Puritas R.T.S. Southbound.
10. Meal allowance
11. Pull-in - arrival back to District.

DRIVER PADDLE-AUTORIDAD METROPOLITANA DE AUTOBUSES, SAN JUAN

01

INFORMACION DE TURNOS DE CONDUCTORES

RUTA

TERMINAL COUNTRY CLUB-LOIZA-SAN JUAN

TURNO	TREN	GAR-REL	JORNADA EMPIEZA	ITINERARIO EMPIEZA	JORNADA TERMINA	ITINERARIO TERMINA	GAR-REL
6010	6012	GAR	518A	533A	118P	103P	REL
	HORARIO DE ALIMENTO: DE			A			

HORARIO Y PUNTOS DE RECORRIDO

NUM. TREN	NUM. GUAGUA	CTRY CLUB	BALD GOB	LLOR TORR	DIEG APDL	PLAZ COLN	PLAZ COLN	APDL DIEG	JUPI LOIZ	AERO PUER	CTRY CLUB			MILLAJE
6012		A 558	610	619	634	654	656	716	731	741	753	110		32.4
6012		A 808	824	833	850	909	911	931	954	1005	1018	270		24.1
6012		A 1033	1051	1100	1118	1138	1140	1206	1224	1235	1248	430		24.1

TARJETA DE CONDUCTOR

1 NUM. EMP. 5

6 TURNO 10: 6010-1

REP. 518A GAR.

TIEMPO ALIMENTO A

11 DIA | 12 FECHA (DIA / MES / AÑO) 17: 2 | 31/12/85

DIA: MARTES

NOMBRE

FIRMA

DIAS LIBRES
SAB Y DOM

MARQUE ENCASILLADO CORRESPONDIENTE			
18		INICIALES	
1			JORNADA COMPLETA
		INICIALES	JORNADA INCOMPLETA
		INICIALES	AUSENTE
34 CLAVE SUP O INSP 37	38 CLAVE DESP 41	42 CLAVE DIR 45	

95 · 96: T.D.
DUP

HORARIO INICIAL		
INICIA JORNADA		
GAR. 518A	I	
INICIA ITINERARIO		
533A	I	
INICIA JORNADA		
	I	********** **********
INICIA ITINERARIO		
	I	********** **********

HORARIO FINAL		
TERMINA ITINERARIO		
103P	T	
TERMINA JORNADA		
REL. 118P	T	
TERMINA ITINERARIO		
	T	********** **********
TERMINA JORNADA		
	T	********** **********

1 NUM. EMP. 5

PARA USO AJUSTES SECCION DE NOMINAS — DIA 31 MES 12 AÑO 85

HORAS REG	HRS PARTIDO	HRS. ALIM	HRS EXTRAS	CONCESION	PREM.	HRS A PAGAR
8.00		1.00				9.00

20 HORAS REG 23	24 HRS PARTIDO 27	28 HRS ALIM 31	32 HRS EXTRAS 35	36 CONCESION 39	40 PREM 43		52 CLAVE OFICIAL 55	95 · 96
								A.J

USE ESTE ESPACIO PARA MARCAR ENTRADAS Y SALIDAS

m	s	m	s	m	s	m	s	m	s	m	s	m	s	m	s	m	s	m	s	m	s

EXTRA AUTORIZADA

DE ____________ A ____________

FIRMA AUTORIZADA

DRIVER PADDLE-CENTRAL OHIO TRANSIT AUTHORITY, COLUMBUS, OH

* FIELDS WEEKDAYS BLOCK 223 REPORT 552A OUT STATION 602A EFFECTIVE 01/06/86

SIGN COACH "CHARTERED." OUT STATION VIA NORTH ON FIELDS AVE TO 11TH AVE, EAST ON 11TH TO I-71 NORTH, NORTH ON I-71 TO MORSE RD, WEST ON MORSE TO HIGH ST, NORTH ON HIGH AND INTO GRACELAND.

RUN	FTNL BWAL	MAIN FTLN	WYNT MAIN	OHIO MAIN	RICH HIGH	BROD HIGH	BROD HIGH	NTWD HIGH	15TH HIGH	GRAC LAND	
619	735	734	722	707	<--	653	653	649	639	620	<
619	740%	741	752	807	816	819	819	824			

IN STAT 832A REGISTER OFF 837A

% 740A SIGN COACH "DOWNTOWN - CHESTNUT & HIGH." USE REGULAR ROUTE AND TIME POINTS TO NATIONWIDE BLVD. IN STATION VIA EAST ON NATIONWIDE TO FOURTH ST, NORTH ON FOURTH TO FIFTH AVE, EAST ON FIFTH AVE TO FIELDS AVE AND NORTH ON FIELDS TO STATION.

---

* FIELDS WEEKDAYS BLOCK 203 REPORT 312P RELIEVE 334P EFFECTIVE 01/06/86

RUN	FTNL BWAL	MAIN FTLN	WYNT MAIN	OHIO MAIN	RICH HIGH	BROD HIGH	BROD HIGH	NTWD HIGH	15TH HIGH	GRAC LAND	
619							334 R	339	350	412	
619	535	534	522	507	<--	453	453	449	439	420	<
619	545	546	557	612	621	624	624	629	640	702	

IN STAT 720P REGISTER OFF 725P

702P LEAVING GRACELAND ON LAST TRIP, SIGN COACH "CHARTERED." IN STATION VIA SOUTH ON HIGH ST TO MORSE RD, EAST ON MORSE TO I-71 SOUTH, SOUTH ON I-71 TO 11TH AVE, WEST ON 11TH TO FIELDS AVE AND SOUTH ON FIELDS TO STATION.

DRIVER PADDLE-KANSAS CITY AREA TRANSIT AUTHORITY, KANSAS CITY, MO

75 3 OIO WORKS 32 Pull out 404 Rel. 557
RUN 76 4 TROOST (1) Rel. 751 Rel. 1057

Troost Weekday Schedule #3 Eff. 9-30-85
Block (1), Line #25
Out - 404

Shep Mews	Int Rev	Ben-Dix	85th Trst	Greg Trst	63rd Trst	47th Trst	39th Trst	31st Trst	18th Trst	11th Grand
			~~425~~	~~S on Trst~~	~~418~~	~~414~~	~~411~~	~~408~~		
(S on W Trst, E on 85th to Paseo-427) (85th Paseo-427, Paseo, 63rd, Trst)										
					436	440	443	446T	450	456
					525	520	517	514	510	505
					537	543	547	551	556	602
	644R		638	634	630	624	620	616	611	605
	644R	646-58B	704	709	713	719	724	729	736	744
			822P	817	813	807	802	757	752	744
			#833P	838#	843	849	854	858	903	910
		952B	946	942	938	932	927	923	918	910
		1009B	1014	1019	1023	1029	1034	1038	1043	1050
		1132B	1126	1122	1118	1112	1107	1103	1058	1050

(Cont'd)

R-Internal Revenue. B-Bendix. P-85th & Troost. *-47th & Troost.
#-Via 63rd, Rockhill, Holmes, Gregory. No Mark-63rd & Troost.

1 Pull out 454 Rel. 1221
RUN 6 INDEP., MO. (1) Rel. 1221 Pull in 717

Independence, Mo. Weekday Schedule #8 Eff. 4-2-84
Block (1), Line #24
Out - 454

Highleah	Lex Osage	Mt Wash	Ave Wall	Ave Winn	Ave Hard	Ave Wood	7th Grnd	9th Grnd	13th Char
	~~525~~	~~513~~			~~505~~				
	525	537			545	553	557		604
707H	655	642			633	625		620	615
722H	734	746			755	805	810		818
			844*		837	829		824	818
			858*		905	915	919		925
			951*		943	935		930	925
			958*		1005	1015	1019		1025
			1050*		1043	1035		1030	1025
			1058*		1105	1115	1119		1125
			1150*		1143	1135		1130	1125
			1158*		1205	1215	1219		1225

(Cont'd)

APPENDIX P

MBTA POINT SHEET-HEATH STREET LOOP

MASSACHUSETTS BAY TRANSPORTAT

13 DEC 85 WEEKDAY ROUTE 39 HEADWAYS AT HEATH S

	LEAVE HEATH	ROUTE	RUN NUMBER	BADGE	IDENT
	735 A	39-6	9075		C03
=8	736 A	39-	1113		C26
X	738 A	39-	1121		C27
X	739 A	39-1	1142		C02
=8	740 A	39-	1114		C28
	741 A	39-8	9076		C04
X	742 A	39-	1116		C29
X	743 A	39-1	1143		C03
	744 A	39-	9042		C30
X	746 A	39-	1125		031
X	747 A	39-1	1148		C07
	747 A	39-8	9077		C05
=8	749 A	39-	1115		C32
X	751 A	39-1	1141		C08
X	752 A	39-	1128		033
	753 A	39-8	9078		C06
X	755 A	39-	1126		C34
X	755 A	39-1	1145		C09
=8	758 A	39-	1111		C01
X	759 A	39-1	1147		C10
	759 A	39-8	9079		C07
X	801 A	39-	1127		C02
X	803 A	39-1	1144		C11
X	804 A	39-	1129		C03
	805 A	39-8	9080		C08
=8	807 A	39-	1118		C04
X	807 A	39-1	1149		013
	810 A	39-	9043		C05
X	811 A	39-1	1150		C14
	811 A	39-8	9081		C09
	813 A	39-	9045		C06
X	815 A	39-1	1146		C01
=8	816 A	39-	1112		C07
=8	817 A	39-8	9073		C01
	819 A	39-	9046		C10
X	819 A	39-1	1142		C02
	822 A	39-	1120		C11
X	823 A	39-1	1143		C03
=8	823 A	39-8	9074		C02
	825 A	39-	9047		C12
X	827 A	39-1	1148		C07
=8	829 A	39-	9041		C15
=8	829 A	39-8	9075		C03
	831 A	39-	1122		C16
X	831 A	39-1	1141		C08
	834 A	39-	9048		C17
X	835 A	39-1	1145		C09
=6	835 A	39-8	9076		C04
	837 A	39-	1117		C18
X	837 A	39-1	1147		C10
=8	840 A	39-	1123		C19

POINT SHEET-TRI-MET, PORTLAND, OR

WEEKDAY HEADWAYS EFFECTIVE JUNE 1985 TRIMET SCHEDULE DEPT. PAGE 39

BURNSTAR WESTBOUN WEEKDAYS LAST UPDATE=14AUG85

POINT : 5TH&BURN 9800

KEY TIME	SAM	PULL OUT	8003 MTHD COLL	197 223D STAR	1443 STAR BURN	202 162D STAR	209 122D STAR	207 105T AVE	205 MALL 205	204 82ND AVE.	202 60TH BURN	201 39TH BURN	1141 12TH SAND	9800 5TH& BURN	531 23RD BURN
5:20A	3								5:19	4:31	3:12	5:42	3:20	5:33	
5:38A	3								7:19	4:41	3:14	6:05	3:34	5:40	
5:58A	2			5:49	4:29	5:04	6:30	2:35	3:24	4:39	3:04	5:40	3:37	6:06	
6:18A	3								5:02	5:11	3:05	5:43	5:36	5:40	
6:34A	3			5:23	4:31	4:23	6:09	2:13	3:37	4:15	3:40	5:49	4:55	5:50	
6:49A	3								4:12	5:17	3:59	6:34	4:50	6:50	
7:04A	2			5:25	5:00	5:34	3:00	2:29	3:49	5:20	3:23	7:07	5:30	8:29	
7:19A	2								7:29	6:45	5:00	7:02	5:05	8:22	
7:31A	3			6:15	4:54	5:50	8:51	2:44	3:49	5:20	4:05	6:05	5:20	8:34	
7:43A	3								7:43	6:01	4:44	7:50	5:29	8:10	
7:55A	2			6:11	5:04	6:00	8:07	2:54	4:21	5:37	5:45	7:00	5:30	8:22	
8:07A	3								4:45	5:42	4:53	5:39	5:06	6:15	
8:22A	2			6:38	3:57	4:32	7:40	2:57	4:42	5:48	3:52	7:52	5:52	8:07	
8:37A	2								4:23	5:24	4:39	7:19	4:45	6:45	
8:52A	3			5:36	5:16	5:38	7:05	3:09	5:30	5:48	3:46	6:24	5:26	8:39	
9:07A	2								3:52	4:34	3:33	6:58	4:38	6:37	
9:22A	3			5:50	5:33	5:30	6:06	3:15	5:11	6:33	4:05	7:24	4:24	7:45	
9:37A	2								4:00	5:00	3:43	5:56	5:12	8:22	
9:52A	2			5:39	5:58	5:37	6:45	2:22	5:22	5:40	3:05	6:22	5:22	7:29	
10:07A	3								4:17	5:03	4:00	6:43	4:31	6:30	
10:22A	3			4:58	4:03	6:00	6:03	2:46	4:34	5:14	3:55	6:09	5:25	7:35	
10:37A	3								4:45	5:24	3:44	5:50	4:57	7:20	
10:52A	2			5:30	3:33	6:34	6:07	3:08	4:06	5:30	4:22	7:07	3:52	7:37	
11:07A	2								4:07	4:52	3:15	6:07	3:44	8:00	
11:22A	2			4:57	5:21	5:26	7:41	1:56	5:07	5:30	3:52	6:22	4:15	8:37	
11:37A	3								4:15	4:38	3:47	6:25	4:27	9:05	
11:52A	2			5:34	4:13	6:09	7:07	3:07	4:37	4:45	3:37	6:07	4:15	9:00	
12:07A	2								4:22	5:52	4:20	7:38	5:24	8:15	
12:22A	3			5:27	4:25	4:26	5:56	2:25	6:02	5:39	3:54	7:47	3:44	8:35	
12:37A	2								4:17	4:13	2:55	6:33	6:00	8:07	
12:52A	3			5:36	4:25	4:38	6:34	2:32	5:23	5:01	3:48	6:32	5:43	8:10	
1:07P	2								5:00	4:34	2:28	5:28	5:29	10:15	
1:22P	2			6:07	5:26	5:05	6:29	2:37	5:00	5:00	3:30	6:37	5:15	9:37	
1:37P	3								5:19	4:30	3:44	6:30	5:26	9:56	
1:52P	3			5:19	4:13	4:27	7:29	2:41	4:44	4:55	3:50	6:36	4:39	8:30	
2:07P	3								4:13	4:50	3:34	6:10	4:22	7:55	
2:22P	2			5:13	3:23	4:45	6:39	2:47	3:56	5:33	3:41	9:03	4:49	8:07	
2:37P	2								4:25	3:51	2:50	7:15	4:00	7:45	
2:52P	2			6:30	4:39	5:37	6:09	2:33	4:36	5:00	3:37	5:58	4:46	9:45	
3:07P	3								4:25	5:56	3:34	5:53	4:21	8:45	
3:22P	2			5:57	3:23	4:09	7:07	3:32	3:59	6:00	3:37	7:22	4:37	6:52	
3:37P	2								5:15	5:14	2:46	6:13	6:16	8:07	
3:52P	3			5:10	4:40	4:37	6:40	2:59	5:07	4:59	3:25	5:39	5:34	9:25	
4:07P	2								4:30	4:33	3:04	6:23	3:45	12:37	

POINT SHEET-BC TRANSIT, VANCOUVER, BC

REPORT NO. TK73001

METRO TRANSIT OPERATING COMPANY
TRANSIT SUPERVISORS CORNER BOOKS

02

117:FRASER&41ST
MONDAY-FRIDAY
EFFECTIVE: 03 JAN/86

TIME	N/E RTE	RN	S/W RTE	REC	TIME	N/E RTE	RN	S/W RTE	REC
718		3	41		746	8	16		
720		16	6		746		65	41	
724	8	11			748		28	41	
725		25	41		751	41	22		
726		15	41		752		24	6	
726	41	28			754	8	17		
726	41	1			754		6	41	
730		4	41		758	41	9		
731		17	6		801		1	6	
731	8	12			801	8	20		
733		16	41		802		21	41	
736		17	41		805	41	23		
736	41	21			805		90	41	
737		27	41		807		7	41	
739	8	15			808		2	6	
741		20	6		809	8	23		
742		5	41		813	41	2		
743		23	6		815		22	41	
744	41	8			816		3	6	

01

117:FRASER&41ST
MONDAY-FRIDAY
EFFECTIVE: 03 JAN/86

TIME	N/E RTE	RN	S/W RTE	REC	TIME	N/E RTE	RN	S/W RTE	REC
600		23	6		647	8	2		
607		1	6		649		9	41	
608	41	7			650	41	23		
609		5	41		655	8	5		
611	41	2			656	41	5		
618	8	23			658		10	6	
618		1	41		658		22	41	
618	41	21			703	8	6		
625		2	6		703	41	25		
626	41	3			704		2	41	
627		5	6		705		11	6	
628	41	9			706	41	6		
629		7	41		708		12	6	
637	41	22			710	8	8		
638	8	1			712		23	41	
639		21	41		715	41	27		
641	41	4			716	41	7		
644		6	6		717	8	10		
647		8	6		718		15	6	

POINT SHEET-CNY CENTRO, SYRACUSE, NY

Revised 9-9-85

TIME - POINT - OBSERVATION

DATE________________

LOCATION________________

CHECKED BY________________

DIVISION Liverpool (a.m.)

COMMON CENTER	ACTUAL TIME	BLOCK #	DESTINATION	APPROXIMATE # OF PASSENGERS ON BOARD
7:05A		905	Echo Park 9G	
7:05A		915	King Park 9N	
7:09A		925 AR	Fayette & Salina	
7:15Ax		903	Buckley & Patricia 9K	
7:17Ax		925 LV	Route 57 9M	
7:19A		913 AR	Fayette & Salina	
7:25A		3901	Fayette & Salina	
7:27A		913 LV	Morgan - Oakridge 9T	
7:34Ax		901	Echo Park 9G	
7:35Ax		950	Syracuse University 9S	
7:37Ax		906	Buckley & Patricia 9K	
7:42A		922	Fayette & Salina	
7:44A		911	Syracuse University 9S	
7:47A		923	To Line 211	
7:55A		980	To Line 10	
8:00A		950	Route 57 9M	
8:01A		927 AR	Fayette & Salina	
8:08A		929	Syracuse University 9S	
8:12A		927 LV	Oakridge 9P	
8:14A		912	Syracuse University 9S	
8:15A		923	Morgan Road 9C	
8:17A		915	Syracuse University 9S	
8:19A		905	Echo Park 9G	
8:23A		903	To Garage	
8:38A		925	Syracuse University 9S	
8:43A		915	Morgan Road 9C	
8:46A		906	Buckley & Patricia 9K	
8:46A		913	Fayette & Salina	

PERFORMANCE EVALUATION - ROCHESTER, NY

SUPERVISORS REPORT

DATE____________________ LINE__________
BLOCK____________________ BUS__________
DESTINATION____________________________
OPERATOR__________________ NO__________
LOCATION______________________________
DIRECTION N. S. E. W.

TIME____________________ DUE__________
_____ MINUTES AHEAD _____
WATCH CHECKED _____
OFF ROUTE _____
WRONG DESTINATION SIGN________________
WRONG TRAIN NUMBER _____
RADIO OFF _____
HANDSET NOT IN CRADLE _____
PLAYING TRANSISTOR RADIO
SMOKING ON BUS _____
NOT IN UNIFORM _____
NOT USING TURN SIGNALS _____
UNSAFE OPERATION _____
FAILS TO SHUT OFF MOTOR _____

INSTRUCTED________ NOT INSTRUCTED _____

NOTES__________________________________

SUPERVISOR ________________________

RTS 16

OPERATOR PERFORMANCE EVALUATION SHEET-LOUISVILLE, KY

Form No. 76-1

EXHIBIT V

TARC COACH OPERATORS' ROAD TEST PERFORMANCE EVALUATION

Operators Name ______________________

Badge No. ____________ Date ____________

Route ____________ Run No. ____________

Time On: ____________ Time Off ____________

Time On: ____________ Time Off ____________

Amt of Hours: ____________ Weather ____________

REQUIRED SKILLS

☐ STOPPING	☐ STARTING
☐ DOORS (front)	☐ DOORS (rear)
☐ RIGHT TURNS	☐ LEFT TURNS
☐ APPROACHING INTERSECTIONS	☐ MIRRORS
☐ COURTESY	☐ INFORMATION
☐ APPEARANCE	☐ OPERATION
☐ COORDINATION	☐ ATTITUDE
☐ INITATIVE	☐ COOPERATION

SYMBOLS TO BE ENTERED IN BOXES:

(S) SATISFACTORY-Meets standards

(M) MARGINAL-Below standards-has potential for improvement.

(U) UNSATISFACTORY-Poor performance-needs improvement.

HABITS: ______________________

REMARKS

____

____

____

____

____

INSTRUCTOR ______________________

INSTRUCTOR OBSERVE THE FOLLOWING AREAS OF PERFORMANCE

CHECK ( ) ERRORS ONLY

STARTING AND ATTAINING NORMAL SPEED

1 Checks traffic to rear, alongside, ahead ____

2 Makes initial start smoothly and evenly ____

3 Uses hand and foot controls properly ____

4 Gets bus in direct drive properly ____

5 Respect pedestrians rights ____

INTERSECTIONS

1 Adjusts speed to meet conditions ____

2 Approaches in proper lane ____

3 Responds properly to actions of others ____

BETWEEN INTERSECTIONS

1 Alert to conditions/hazards ahead, to side ____

2 Operates at appropriate speeds ____

3 Keeps in proper lane ____

4 Maintains safe following distance ____

5 Uses good judgment in passing ____

6 Keeps vehicle under full control ____

MAKING TURNS—LEFT/RIGHT

1 Checks traffic to rear, alongside, ahead ____

2 Approaches in proper lane ____

3 Signals intentions clearly ____

4 Approaches at proper speed ____

5 Allows other traffic to clear ____

6 Protects right side before, during and after ____

STOP SIGNS

1 Comes to a complete stop ____

2 Proceeds only when safe ____

STOPPING FROM NORMAL SPEED

1 Brakes gradually and steadily ____

2 Allows ample distance ____

3 Releases brake pressure at proper time ____

STOPPING AT CURB

1 Checks traffic to rear, alongside, ahead ____

2 Approaches in proper lane ____

3 Approaches at proper speed ____

4 Stops close up and parallel to curb ____

5 Selects suitable alighting point ____

6 Keeps doors closed until stop completed ____

STARTING UP FROM CURB

1 Closes and watches doors before starting ____

2 Checks traffic to rear, alongside, ahead ____

3 Proper use of mirrors ____

RAILROAD CROSSINGS

1 Comes to a full, gradual stop ____

2 Stops at proper distance (10-50 ft) ____

COURTESY

1 Generally courteous to passengers and rights of others ____

FARES

1 Familiar with fare structure ____

2 Observes fares deposited ____

3 Issues and inspects transfers properly ____

4 Does minimum of work while driving ____

TRANS 19
REV 8/84

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
EMPLOYEE'S PERSONNEL RECORD MEMORANDUM

Division No. ______________ Date of Occurrence ______________

The rule violation checked below will be placed on your personnel record seven days from the indicated date above and it is not necessary for you to contact the Division Manager unless you feel there is some reason that this violation should not be placed on your record.

NAME ______________ BADGE NO. ______________

LINE ______ BR NO. ______ VEHICLE NO ______ DIRECTION ______________

ASSIGNMENT NO. ______________ TIME ______________

PLACE ______________ INSTRUCTED ______ OBSERVED ______ CLASSIFICATION ______

RULE VIOLATION

	1. Appearance		6. Dash Signs		11. Schedules		16. Bus Run Number
	2. Commendation		7. Equipment		12. Smoking		17. Uniform
	3. Destination Signs		8. Freeway/Busway Operation		13. Stops		18. Fare Checking
	4. Directional Signals		9. Operator/Passenger Relations		14. Terminal/Station Operation		19. R.T.D. Rule
	5. Dispatcher-Radio Div.		10. Running Sharp		15. Traffic Violation		20.

Remarks: ______________

MAKE IN TRIPLICATE SIGNED ______________

RTO 32-19 G
EFF 11/83

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
EMPLOYEE'S COMMENDATION MEMORANDUM

Division No. ______ Date of Occurrence ______________

A copy of this memorandum will be placed on your Personnel Record within seven days from the indicated date above in recognition of the exceptional performance noted.

Name ______________ Badge No. ______________

Line ______ BR No. ______ Vehicle No. ______ Direction ______________

Assignment No. ______________ Time ______________

Place ______________ Observed ______________ Classification ______________

	1. Appearance		6. Reporting Hazards		11. Special Events		
	2. Assistance to Operator		7. Safe Operation		12. Traffic Courtesy		
	3. Assistance to Public		8. Schedule Performance		13. Other		
	4. Bus Cleanliness		9. Service Assistance				
	5. Cooperation		10. Service Suggestions				

Remarks: ______________

TRI-MET Customer Contact Report

4012 SE 17th Avenue, Portland, Oregon 97202

SERIAL NUMBER

Date Received ____/____/____

Date of Incident ____/____/____

Time of Incident ____ a.m. ____ p.m.

Location of Incident ________

Route # ____ Bus # ____ Train # ____

Boarding Time ____ a.m. ____ p.m.

Direction: Inbound ☐ / Outbound ☐

CUSTOMER NAME ________

STREET ____ CITY ____

ZIP ____ PHONE ____

Employee Description ________

Customer's Remarks ________

TYPE OF CONTACT
1. Commendation
2. Suggestion
3. Service Request
4. Complaint

RECEIVED VIA
- M Mail
- T Telephone
- P Person

ANSWER NEEDED
- W Written
- V Verbal
- N No Answer

Recorder's Name ____ Department ____ Phone ____

Reply to Customer Services ________

311-0265

For Customer Services Office Use Only

CONTACT CATEGORY

Code
1. Employee attitude/conduct
   - 01. Public relations
   - 02. Careless/reckless driving
   - 03. Wrong information
   - 04. Employee appearance
2. Service Reliability
   - 01. Early
   - 02. Late
   - 03. Missed stop
   - 04. Missed transfer point
   - 05. Bus did not show
   - 06. Off route
   - 07. Disturbance
   - 08. Other/miscellaneous

Routed to: ____

Code
3. Planning/Schedules
   - 01. Limited buses/expresses
   - 02. Schedule
   - 03. Overload
   - 04. Service request
4. Customer Services
   - 01. Fare
   - 02. Transfer
   - 03. Advertising
   - 04. Timetables
   - 05. Maps
   - 06. Phone Information
5. Facility/Equipment Main.
   - 01. Information display
   - 02. Shelters
   - 03. Bus stop sign
   - 04. Dirty equipment
   - 05. Faulty equipment

DEPARTMENT LOCATION CODE

Administrative Department [1] Center [2] Merlo [3] Powell [4]

1. OPERATIONS DIVISION
   1. Operations
   2. Transportation
   3. Buildings and Grounds
   4. Maintenance
   5. Scheduling
   6. Management Services
   7. Transit Police
   8. Claims
2. FINANCE DIVISION
   1. Finance
   2. Data Services
   3. Purchasing & Stores
   4. Management Info. & Analysis
3. PLANNING & DEVELOPMENT DIVISION
   1. New Development
   2. Contract Administration
   3. Service Planning
   4. Light Rail
   5. Special Projects/ Self Service Fare
4. PUBLIC AFFAIRS & MARKETING DIVISION
   1. Public Affairs
   2. Marketing
   3. Carpool
   4. Special Needs Transportation
   5. General Manager

Area Code
N; S; E; W; NW; SW; SE; NE; DT (Downtown); VA; (Vancouver)

Employee Information

Name ________

ID Number ________

Supervisor's Name ________

Review Date ____/____/____ Date of Answer ____/____/____

I have seen and understand this Contact Sheet

____

citran

CONTACT SLIP

Date: ______________________

Bus No.: ____________________ Employee: ____________________

On ____________________ at ______________ you were observed:
(date) (time)

This is a violation of Company rules. You should take immediate steps to improve your performance.

Supervisor

Action:

Signature/Title Date

GEN031-5/83

APPENDIX R

MBTA ON-BOARD EQUIPMENT CHECK-LIST

RADIO CAR CHECK LIST RESERVOIR STATION

TRANSPORTATION DEPARTMENT

DATE ______________

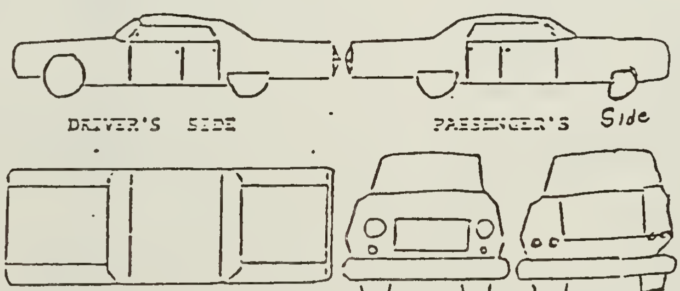
HOURS OF DUTY:

START: ______________ FINISH: ______________

CAR NO. ______________ PROPERTY NO. ______________ REG. NO. ______________

Spot Light	____	Fire Exting.	____	Tape Measure	____
Siren System	____	Bolt Cutters	____	Flares	____
Portable Radio	____	Jumpers	____	Pliers	____
Radio	____	Handlight	____	ScrewDriver	____
Strobe Light	____	Trolley Pick Up	____	Trolley Jumper	____
BullHorn	____				
Electric Siren System	____				
Body Condition	____				
Tires	____				
Inter/Condition	____				
Spare Tire	____				
Tire Jack	____				
Lug Wrench	____				
Brakes	____				

Present Damage to Vehicle (Indicate Damaged Area by Shading the Drawings)



DRIVER'S SIDE PASSENGER'S Side

TOP VIEW FRONT REAR

MILEAGE START ______________ MILEAGE END ______________ TOTAL MILEAGE ______

LOCATION OF VEHICLE AT END OF TOUR OF DUTY ______ Reservoir ______

KEYS TURNED IN YES /_/ NO /_/

____

SIGNATURE OF INSPECTOR

[illegible]

NJ Transit Bus Operations Inc.
DAILY REPORT
Regional Supervisor - Equipment Check List

UNIT LICENSE NO	Vehicle No.	DISTRICT NO.	Date	MILEAGE - FINISHED
GARAGE LOCATION	NAME		Employee No.	STARTING TOTAL

EQUIPMENT IN UNIT	YES	NO	EQUIPMENT IN UNIT	YES	NO
CLIPBOARD			COLOR FILM		
CAMERA & CASE			FLASH CUBES		
FIRST AID KIT			MARKING CHALK		
SCREWDRIVER (SET 6)			FELT PENS		
50' TAPE MEASURE			FUSES		
PINCH BAR			WINDOW CLIPS		
ALAN WRENCHES SET			BULBS		
HAMMER			SPEEDY DRY		
VISE GRIPS (1)			FLARES		
PLIERS (1)			HEADLAMPS		
8" CRESENT WRENCH			MIRRORS		
12" CRESENT WRENCH			WIPER ARMS		
UTILITY KNIFE			WIPER BLADES		
FLASHLIGHT			DUCT TAPE		
TOOL BOX & LOCK			MASKING TAPE		
WATER CAN			WIPE CLOTHS		
FIRE EXTINGUISHER (2)			SNOW CHAINS (BUS)		
RAINSUIT			HAND CLEANER		
JUMPER CABLES			GLOVES		
BULL HORN			SNOW CHAINS (CAR)		
ROUTE BOOK			SAFETY VEST		
Spare Tire			M.C.I. Ratchet		
Tire Jack			Rock Salt		
4-Way Lug Wrench			Flasher		
REMARKS			Wheel Chair Crank		

ATLAS BOOK MAPS

NEW YORK CITY	PHILADELPHIA/CAMDEN
BERGEN/ROCKLAND	MORRIS/SOMERSET
UNION HUDSON ESSEX	MIDDLESEX
MONMOUTH	MERCER
OCEAN	PASSAIC

CHECK OVER MAPS IN UNIT
ATTACH TO SUMMARY

FROM THE CHICAGO TRANSIT AUTHORITY FIELD SUPERVISOR'S
BUS TROUBLESHOOTING GUIDE

Problem	Series	Procedure
Defroster Motor Does Not Work		- arrange to trade off bus as soon as possible • if visibility is poor and window cannot be cleared by wiping, as in frost conditions, - trade bus off with a pull-in or instruct operator to pull in
Destination Sign Will Not Turn	All	• open compartment door • check if sign rod has fallen from brackets • if so, - remove safety chain - replace rod starting with left bracket first. A screwdriver may be needed to wedge bracket on right side before rod will slide in properly - replace safety chain - close compartment door and check if sign moves • if this fails or if sign is rolled too tightly to turn, - instruct operator to continue in service until it is convenient for bus to be traded off, pulled in or exchanged through a bus order
Doors Front Door Won't Open or Close One of the Front Door Panels Won't Open	All	• if the door can be pushed open by hand, the door control rod, clevis pin or shear pin may be broken or missing • **open door control air shutoff valve** • if parts are available (with exception of shear pin), replace them • if unable to replace parts, - call for the mobile truck or - take the bus out of service

Problem	Series	Procedure
Rear Door Fails to Open	7000-7019 7100-7224	• check left exterior panel for a tripped breaker - if breaker tripped, reset it • call for the mobile truck or • trade bus with a pull-in or • order a bus and instruct operator to continue in service to bus exchange point using only front door
Rear Door Fails to Close	All	• shear pin could be broken - report findings to Control
	7000-7019 7100-7224 9000-9799 (52-64) 9800-9974 1600-1624	• door touchbars could be defective - tap each touchbar several times
	1000-1524 3700-3875 7400-7944 (40-51)	• closing mechanism could have come off of sleeve - while holding door closed, replace mechanism
	All	• if door still won't close, - call for the mobile truck or - take the bus out of service; manually secure door with wire or rope
Rear Door Is "Pumping" Open and Closed	7000-7019 7100-7224 9000-9799 (52-64) 9800-9974 1600-1624	• rotate each touchbar separately • if problem still exists, - turn door master switch off - instruct operator to remain in service using only the front door - make arrangements for bus to be traded off, pulled in or exchanged through a bus order

APPENDIX S

HALIFAX [NS] METRO TRANSIT AUTOMATIC VEHICLE MONITORING

"GoTime" In Halifax

Innovations in bus communications can sometimes be found in out-of-the-way places. Take Nova Scotia, for example.

By Stephanie Frederick

Metro Transit of Halifax-Dartmouth, Nova Scotia is introducing the technology of the the airlines into its bus operations: not swept-back wings for its GM of Canada Classics; but an innovative computer-based monitoring system. Called "GoTime," it informs the riding public about the "whens" of bus arrivals and delays even as it informs transit management about the "whys."

"GoTime" was developed by the Systems Department of the City of Halifax for the area's Metropolitan Transit Commission. The unique program is scheduled for a mid-1985 start-up in this growing commercial region of 280,000, set like a small, elegant San Francisco-Oakland on either side of a spectacular bay.

Stephanie Frederick is a free-lance writer based out of Los Angeles.

System operation

This is how "GoTime" will work:

Each vehicle in the 142-bus fleet will carry an onboard microprocessor (by Gandalf) that will feed information to a Hewlitt-Packard 1000 located in the Metro Transit headquarters in Dartmouth, Halifax's sister city across the harbor. This information will include constant updates on each bus's location and adherence to schedule, and data on the number of passengers (collected by London Mat treadle mats) aboard at any time; each microprocessor will also report whether its vehicle is suffering from a hot engine, low oil, low air, no battery charge, or transmission defects. The microprocessors will also be able to access certain information from the large mainframe computer.

A controller (human) in the Metro headquarters, continually monitoring the data compiled by the HP 1000, will be able to contact buses at will to acknowledge problems or communicate information. The system will allow the controller to speak with individual drivers, with all drivers on a given route, or with the entire fleet at one time. Drivers in turn will be able to speak with the controller on request.

As the HP1000 receives data from the buses plying the streets of the metropolitan area, it will constantly revise the buses' estimated departure times from the stops along their routes. At an initial 12 sites in Halifax-Dartmouth (shopping malls, transfer points, the bus terminal near the Halifax CBD), this information will be displayed for the public on terminals of the kind used in airports.

More efficiency

"The benefits of GoTime are numerous," notes Kenny Silver, schedule planner for Metro, "both tangible and intangible."

Productivity of drivers and routes

Reprinted with permission from Metropolitan, March/April 1985.

should be more easily ascertained than at present. Which routes are not contributing enough riders, which routes are overburdened, which drivers are consistently behind schedule: such knowledge is essential for correcting problems, but is usually obtained with difficulty in more traditional operations. The treadle mats used to track the number of passengers aboard will be installed on two front-door steps and on one rear-door step of each bus. The computer will be able to distinguish between passengers boarding and alighting through the front door by the sequence in which the mats are depressed; as the rear door is used for alighting only, a single mat will suffice there. (The wide front entrance of the Classics will require a pair of mats placed side-by-side on each step.)

Coordinated rerouting around accident scenes and road work should be more readily accomplished, since the controller may communicate to drivers what lies ahead and what evasive action should be taken.

The buses should operate in better condition, as well. "Timely maintenance information will help minimize serious breakdowns and help in planning bus maintenance," Silver points out.

Shorter cold waits

The users of the transit system, of course, will benefit most of all. In addition to riding buses that are routed more efficiently and maintained in better working condition, the passenger public will possess a superior knowledge of the comings and goings of their buses. For riders catching buses at terminal display points, a glance at the screen will tell them whether they have time to stop in one more shop or time to finish a conversation or a cup of coffee before heading out to the bus stop.

More comprehensively, every bus stop in the service area will be assigned a unique telephone number. When patrons dial the number of their stop, "GoTime" will report to them the departure times of the next two buses due along that route. Those reported departure times will also be real-time, computer-aided estimates of vehicles' progress, not schedule information, thus permitting patrons everywhere in the area greater control over their own time.

This freedom through information, provided via computer terminals and telephones, would be a

As Halifax becomes a burgeoning metropolis, efficient road utilization will become increasingly important. This new communication system allows up-to-the-minute schedule information and attempts to lure drivers out of their cars and into the buses.

big plus for patrons of any transit system. In a region where the temperature falls to 0 degrees Fahrenheit in February and annual snowfall is over six feet, it is an innovation that quite simply makes bus usage more possible — not just more convenient — all year round.

Finally, to make transit information available in still another way, the authority will install speaker phones at a number of stops not served by display terminals. Activated by push button, each speaker will provide schedule information for its particular stop.

Because of the ease of usage added to the bus system, another benefit may accrue from "GoTime" increased ridership. Since it was formed in 1981, the Metropolitan Transit Commission has attempted (in more traditional, non-computer-based ways) to attract greater numbers of riders.

The commission has altered routes, introduced peak-hour express service into the suburbs, disseminated highly readable route maps and individual route schedules, and run advertisements on local television to encourage off-peak ridership. In one commercial,

the viewer regards a downtown parking meter as it ticks remorsely through its last pennies' worth of time. The pointer suddenly snaps into violation. Says a quiet voice, "These 30 seconds were brought to you courtesy of Metro Transit." The commercial reflects the growing pressure of automobile traffic into the Halifax CBD.

Metro Transit also provides transportation to the handicapped through a dial-a-ride service. Their small vans, brightly lettered "ACCESS-A-BUS" in blue and green, dart about the metro area, picking up and delivering patrons by appointment.

Thoughts to the future

The various efforts to provide improved service and attract riders resulted in Metro Transit's capture of eight percent of all trips generated in the region (15 percent peak hour) for a total of 13.8 million per year. "GoTime," which will not expand the bus system but will immensely expand its *usability*, may also be expected to increase the transit district's ridership. In addition to helping patrons make better use of their time, the display terminals will continually announce Metro Service to patrons and potential patrons alike.

Metro Transit could have opted to buy additional buses and hire more drivers. Since oil has been discovered on Sable Island to the east and since the Halifax container facilities are now funneling more and more goods into interior Canada, the population is growing steadily, and the "natural" demand for transit service is expected to increase. But simply placing more vehicles on the street might not have been an appropriate response to the true nature of the modern demand for transit, which requires service that better competes with the advantages of the automobile.

The cost of the new technology is high but perhaps not exorbitant, considering the multiple benefits. "Go-Time," as it will be initially installed with its mainframe computer, 142 microprocessors, 12 display terminals, digitized voice equipment (by Votrex), and 45 treadle mats, with the software to tie it all together, will require a capital outlay of C$1.35 million (US$1.08 million). In addition, Metro must pay the salary of its controller and cover the costs of maintenance and repair of the electronic equipment.

Metro, however, may expect to realize quickly a return on its investment in the form of reduced vehicle maintenance costs and increased patronage and productivity. Even more important, as Halifax-Dartmouth, with its increasingly busy container facilities and rapidly developing CBD, evolves into a major North Atlantic metropolis, a modernized transit system will already lie at the heart of city operations. Helping to minimize the congestion, parking, and pollution problems that afflict large cities of the present era, "GoTime," ahead of its time, will already be quietly at work.